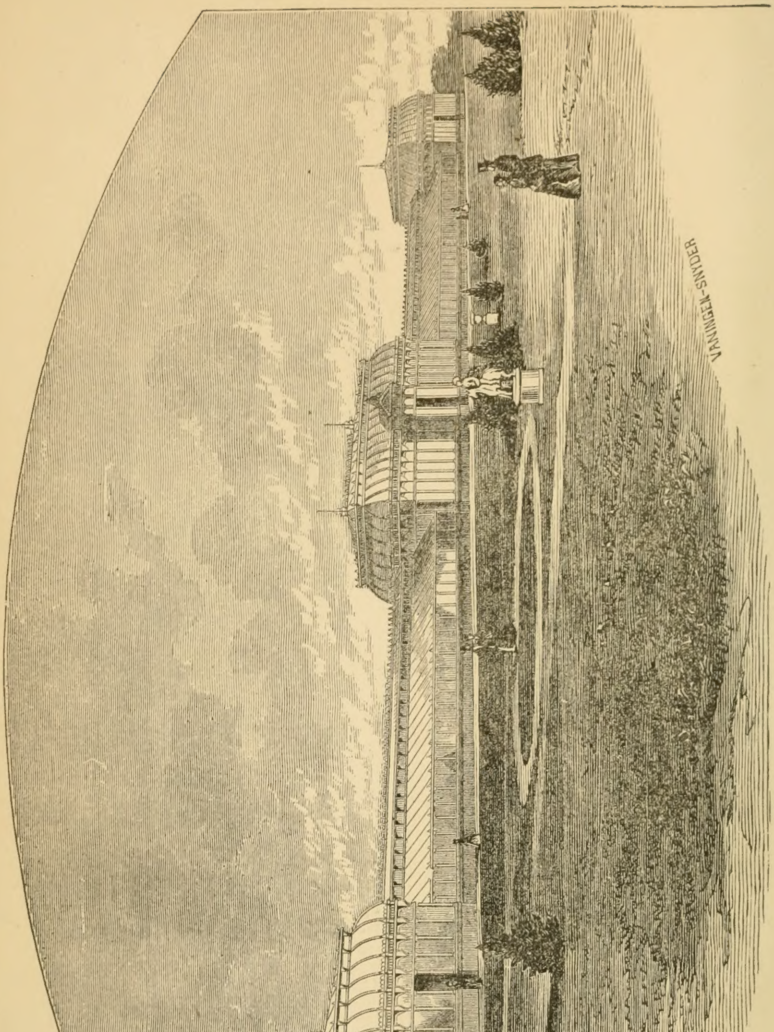
PLATE I.



CONSERVATORY OF THE DEPARTMENT OF AGRICULTURE.

REPORT

OF THE

COMMISSIONER OF AGRICULTURE

FOR

THE YEAR 1870.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1871.

FORTY-FIRST CONGRESS, THIRD SESSION.

OFFICE OF THE HOUSE OF REPRESENTATIVES,
March 3, 1871.

The following resolution, originating in the House on the 28th ultimo, amended in the Senate on the 2d instant, was this day concurred in by the House:

Resolved by the House of Representatives, (the Senate concurring,) That there be printed, of the Annual Report of the Commissioner of Agriculture for 1870, two hundred and twenty-five thousand extra copies, one hundred and fifty thousand of which shall be for the use of the House, fifty thousand for the use of the Senate, and twenty-five thousand for distribution by the Commissioner of Agriculture.

Attest:

EDW. McPHERSON, *Clerk.*

CONTENTS.

ILLUSTRATIONS.

REPORT

OF

THE COMMISSIONER OF AGRICULTURE.

DEPARTMENT OF AGRICULTURE,
Washington, D. C., December 1, 1870.

SIR: In submitting the ninth report of the Commissioner of Agriculture, I have the gratification of representing the foundation interest of the country as prosperous and productive in a high degree—an interest which is the source of supply of the physical wants of all classes, and the nursery of energy and virtue for the equally essential recuperation, from waste and enervation, of the less healthful pursuits of life.

The season has been one calculated to test severely the capabilities of our soils. On the eastern slopes of the Alleghanian system, excessive rains at a critical period were followed by a lengthened drought; and throughout a large area of other sections of the country, unusual elevation of temperature has been combined with a diminished precipitation of rain, seriously affecting the vitality of plants weakened by starvation, shallow culture, overgrowing weeds or grasses, or imperfect drainage. Local decrease of small grains has resulted from these causes, counterbalanced in part by local compensations from climatic or other influences; yet the effect of high temperature has been so conducive to the growth of maize, the most valuable crop in our arable culture, the predominant element not only of the breadstuffs but of the meat production of the country, that the material for food supplies of the year is greater than usual.

The fact of increased production in a season remarkable for excessive heat, in a country assumed to be liable to injurious extremes of temperature and seasons of continued aridity, affords strong evidence of the available depth and fertility of our arable lands. The local diminution of yield enforces many a lesson of needed improvement in the drainage, comminution, and amelioration of imperfect soils.

An examination in detail of the facts of this year's production, in the light of enlarged agricultural experience and of science applied to husbandry, would furnish hints to improvement and aids to progress, which, if adopted generally, would increase the value of farm production to the extent of five hundred millions of dollars. It would do more—it would tend to the increase of the fertility of the soil, which now, in nine farms out of ten, is annually decreasing, and it would proportionably advance its intrinsic as well as market value.

It is gratifying to believe, from indubitable evidence, that the examples of rational and recuperative culture are relatively increasing, however slowly, and gradually making inroads upon the destructive, irrational modes so generally prevalent. These examples are most numerous in the Middle States, are seen with comparative frequency in the older sections of the West, are found occasionally in New England, and are beginning to be noted in the Southern States; but there is no State in which exhaustive and irrational culture is not predominant. While the cost of good land is less than the interest on its intrinsic value, and its yearly income may be enhanced at the expense of the permanent investment, there is little hope that present necessity or short-sighted greed will fail to work its impoverishment; but with high prices, both of land and labor, it is more than folly to expect remunerative profits from unsystematic and unscientific culture.

The grower of tobacco, turning out his old fields to sedge and "poverty grass," with the full conviction that his crop is inevitably destructive to fertility, has now an occasional opportunity to learn that heavy yields are not inconsistent with annual improvement.

The wheat-grower of Genesee, despondent over the waning productions of his fair fields, can turn to the example of a progressive neighbor and witness the old munificence returning through the avenue of systematic rotation.

In Illinois, the specialist in wheat, taught wisdom by many lessons of experience and observation, is rapidly learning that prairie soils may be enriched by alternations of grass and roots with corn and wheat, all except the wheat being converted into meat, milk, butter, cheese, &c., upon the farm.

And cotton-growers are learning that, with a monopoly of their staple, a climate unsurpassed for perfecting it, and some of the richest lands of the world for its cultivation, their section has grown poorer with its continued culture, and can nowhere show a valley so replete with all the elements of wealth as that of the Mohawk, so long carpeted with grass and flecked with cattle. Profitable as cotton may be, and rich as the best southern soils surely are, its culture, as a special crop, apart from suitable alternating growths, will ultimately result in poverty and barrenness.

The enlightened agricultural economist, in deprecating exclusive special culture, whether of cotton, wheat, or other crops, objects to the irrational mode of cultivation, and not to the amount of production—inveighs not against a surplus, but opposes a practice reprehensible and ruinous, which tends directly and speedily to defeat the object of culture and to belittle the rewards of labor.

INDUSTRIAL EDUCATION.

The organization of industrial colleges, under the land grant of Congress of 1862, chronicled in recent annual reports of this Department,

has progressed during the past year. The Ohio College has been located in the vicinity of Columbus, with a fund of nearly half a million of dollars from proceeds of lands and a donation of \$300,000 from Franklin County. The Missouri Institution has also been organized, in Boone County, with local donations exceeding two hundred thousand dollars, and 330,000 acres of land located under the congressional grant. Colleges had previously been organized, or departments of agriculture added to existing institutions, in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, West Virginia, Kentucky, Michigan, Wisconsin, Minnesota, Iowa, Kansas, and California. Nebraska is now perfecting an organization, and other States may have taken steps in that direction, of which no official or other information has been received.

The land scrip has been issued to most of the Southern States, and a portion of it has been sold, but I have heard of no action toward organization of colleges, and fear that the scrip has, in some instances, been frittered away by sales at nominal prices, as has been the case in many of the Northern and Eastern States. It is to be regretted that restrictions against sales at lower than Government rates had not been imposed upon the trustees of these institutions. Perhaps it would have been better still to have required the actual location of these lands, which would inevitably have resulted, under judicious management, in an ultimately larger income from rentals or subsequent sales. The more western States all pursued this course, with a fair prospect of realizing five dollars per acre instead of fifty to seventy-five cents.

I am confident that these institutions are destined to become a vital power in the land, and to wield an influence which colleges weighted with a "curriculum" of studies of classical ages can never exert; but it will be many years before their best fruits will begin to appear, and many mistakes will be made, (some of them, possibly, almost fatal in their character,) misconceptions of the sphere of their highest utility will occur, and inefficiency will undoubtedly mar the beauty of their practical results; but ultimately, when the grand idea of practical education in America shall be fully crystallized, and their faculties shall be composed of young and vigorous men developed within these institutions and under the influence of higher progression in physical and practical science, their true utility and beneficent influences will begin to appear.

I would respectfully suggest the importance of an authorization, by Congress, of a commission, under the direction of this Department, to examine minutely the plan of organization, the construction of buildings, management of grounds, and general workings of the industrial colleges organized under the congressional land grant, with instructions to report to the next Congress, for the information of the country and the benefit of institutions of similar character yet to be organized.

STEAM-PLOWING.

The inventive mind of the country is strongly stimulated with the hope of educing a distinctively American machine, better adapted to the peculiar necessities of our agriculture than the most successful foreign apparatus. The Report for 1869 contains descriptions and illustrations of several patents of that year, and the volume for 1870 will show that these efforts have been continued during the present year. It is to be regretted that so many still adhere to the impracticable idea of locomotive traction. The reports of the actual work of the five steam-plows now in operation in this country are extremely favorable to the idea of ultimate success in the solution of the problem of steam-plowing as an adjunct of our agriculture.

SILK CULTURE.

Silk culture in California has been attended with great success up to the present time, producers claiming that the climate of that State is peculiarly adapted to the rearing of silk-worms, on account of the dryness and equality of the temperature, and the rare occurrence of severe thunder storms. In Utah experiments have been made, with success, in feeding the worms upon the leaves of the Osage orange instead of the mulberry. The Japanese silk-worm, *Samea cynthia*, on the ailanthus, is now perfectly acclimated, and breeds in the open air in Brooklyn, Philadelphia, and other places, but as yet I have heard nothing of the use of its cocoons in manufacture. Two other silk-producing worms, *Attacus yama mai* and *pernyi*, have been bred this season in Brooklyn, but are yet too scarce for a proper test of their value.

GOVERNMENT PLANTATIONS OF CINCHONA TREES.

Among the trees which may be introduced and acclimatized in our territory, there is none deserving more consideration than the Peruvian-bark tree. Both England and France have deemed it necessary, in view of the increasing scarcity of quinine, to establish in their colonies plantations of the Cinchona tree. Its essential product is furnished to the world from a narrow belt on the slope of the Andes in Peru and Bolivia. The supply is limited and precarious, with no means of extension by propagation or cultivation in these South American nations. The tree is of rapid growth in favorable localities, and after six years may become an article of commerce. The commencement of cultivation ought not to be left to private enterprise, but should be initiated and supported in its early infancy by the establishment of one or more national plantations at points selected on account of their favorable climatic influences. The time is now opportune for commencing such a work, since a supply of young trees is easily obtainable from a source whence no real difficulty arising from transport and transplantation would occur.

The propagation of the Cinchona has been commenced in the experi-

mental division of this Department, with highly successful results; and several hundred specimens now on hand will be increased to thousands whenever facilities are afforded for testing the feasibility of successful growth in the open air.

I earnestly hope that an appropriation will be granted by Congress for this purpose.

DEPARTMENT OPERATIONS.

The field of labor is so broad, the objects of attainment so manifold, in aid of progressive agriculture and enhancement of its productive resources, that the limited means at the disposal of the Department appear inadequate to the great work in hand. Yet a fair exhibit of its operations, it is confidently believed, will attest the wisdom of its origination and the profit of its labors.

Its work demands a higher order of talent than the routine service of most public business; it requires a knowledge of national economy, social science, natural history, applied chemistry, animal and vegetable physiology, and practical agriculture; and presents so broad a range of facts in each field of investigation as to demand the most active effort and the most persistent industry. For such labor the most meager compensation only is offered, and it is found difficult to obtain an increase of suitable service, and impossible to remunerate properly that already employed which is found to be most efficient and reliable, while that which is practically useless for the purpose is offered in unlimited measure. A just and wise revision of clerical salaries would greatly increase the efficiency of the Department.

The work of the past year includes the collection of the facts of production and experiment throughout the world, the publication of general and special reports, investigations in natural science in its relations to rural efforts, the introduction and propagation of many new and promising plants, and the increase and improvement of farm products by the dissemination of seeds and plants. Results of the most successful character in these directions will be shown in subsequent paragraphs, and in the accompanying reports of operations.

THE STATISTICAL DIVISION.

This division is the office of publication of the Department, and has issued during the past year the monthly reports and the annual for 1869, prepared for publication the cattle-diseases reports, furnished statistical statements for congressional uses, and similar responses to inquiries of commercial and industrial boards or societies, and of individuals. The facilities employed in these investigations include not only trained and experienced correspondents representing about 1,300 counties, but the officers of an equal number of industrial societies of all grades, special correspondence with practical scientists and experts, and exchanges with governments and societies abroad. Foreign and domestic

serial literature, industrial and commercial, is also explored for the extension, comparison, and verification of results. Difficult and arduous as are the labors required, and small as are the pecuniary means appropriated to the purposes of this division, abundant testimony is received of its comparitive efficiency and practical value.

CATTLE DISEASES.

I have heretofore called attention to the imperative necessity for establishing a division of veterinary surgery in this Department. The value of stock lost annually from disease is enormous, and threatens not only to decimate our animals, but to expose the human family to disease from the consumption of unwholesome meats. Neglect of animals, and their overcrowding in transportation, are prolific sources of disease, and its spread is permitted by the ignorance of a majority of the present class of veterinarians. Another class of disease arises from causes but obscurely known, if known at all, and these fatal maladies are as yet without any indicated effort of cure, rendering necessary the barbarous plan of stamping out, recommended and adopted in other countries as well as our own, as the only means of saving the agriculturist or stock-raiser from total ruin.

A quarto edition of the reports arising from the cattle-diseases investigation, conducted under the auspices of this Department, some of them never before published, is in course of publication. The volume will include reports as follows: A prefatory report to Congress by the Commissioner of Agriculture; one upon pleuropneumonia; on the effects of smut and other fungous growths upon corn and forage; the periodic or splenic fever of cattle, (the Texas cattle disease;) the pathological anatomy and histology of the respiratory organs; microscopic examinations of cryptogamic growths in fluids of diseased animals; and the statistical history of the Texas cattle disease. These reports will be illustrated by numerous chromo-lithographs, micro-photographs, copper-plate and wood engravings, the work of the best artists, from originals prepared in the office of the Surgeon General of the United States.

ENTOMOLOGY.

The correspondence of the entomological division has largely increased during the year, inquiries in regard to noxious insects having been received from all parts of the country.

The cotton army-worm appears to have been less destructive than usual, and few complaints of loss from other cotton insects have been made, while insects injurious to fruits and vegetables have been unusually numerous and destructive.

It is in contemplation to publish, whenever suitable authority is given for the printing and illustration, a work on entomology, prepared by the entomologist of the Department, in which known American insects of each order will be accurately figured upon copper-plate, and which has

been declared, by those competent to judge, the most complete and exhaustive effort ever made in this direction. It will be a valuable aid to practical entomology, and a desideratum for State entomologists and the naturalists of agricultural colleges, upon whose investigations and suggestions depends the possibility of reducing in some degree the losses from insect ravages, which are annually computed by tens and even hundreds of millions.

An appropriation having been made at the last session of Congress for the purpose of obtaining models of the fruits best adapted to certain localities, the work has been commenced with a large collection of apples particularly adapted to the Southern and Middle States, and will be continued with new varieties from other sections of the country.

THE AGRICULTURAL MUSEUM.

During the year many valuable additions have been made to the museum, under the charge of the entomologist, by voluntary contributions or exchange, without the aid of any appropriation whatever for the purchase of new or rare specimens. The collection of fibers from abroad has been increased by a series of articles of lace-work and embroidery equaling in beauty the finest point-lace, manufactured by the peasant women of Fayal, Azores, from the bitter aloe. From Basle, Switzerland, a fine collection of articles of silk manufacture has been received, together with samples of the aniline dyes used in coloring them. Samples of manufactured California silk have also been received. A series of cotton samples from countries other than the United States, in use in England during the late war, illustrates the effort then made for a supply during the cotton famine. Among other contributions may be mentioned samples of fruits, grains, and other farm products from agricultural fairs in the West and South, and from individuals in various parts of the country, birds, insects, and other specimens of natural history.

BOTANICAL COLLECTIONS.

The Department herbarium continues to receive large accessions to its material for systematic study and illustration of the vegetable kingdom. The additions for the present year already exceed four thousand species; these include a nearly complete set of Cuban plants procured from Mr. Charles Wright, an excellent botanical collector. Large and valuable collections have been received through the Smithsonian Institution from several of the learned societies of Europe, which give expression to an earnest desire to procure American plants and seeds in return. The various Government explorations now in progress, and local collections from Army officers stationed at different frontier military posts, are constantly affording a large amount of material for the purpose of exchange and distribution. Dr. E. Palmer, who has been making special collections for this Department in the Western Terri-

tories, has forwarded from time to time living and dried plants and seeds. This collection is now in process of elaboration by the distinguished American botanists, Drs. Gray, Torrey, and Engelmann, and includes a considerable number of plants new to science, which will be greatly prized by scientific botanists, and eagerly sought by botanical institutions at home and abroad.

The design of establishing at the seat of Government a collection of plants worthy the name of a national herbarium is thus in process of rapid accomplishment, at comparatively small cost; and it is confidently expected that this collection, now probably the third in point of size, will eventually exceed all others in the amount and value of its material for illustrating North American botany.

With a view to acquiring more direct information of the manner of arranging and displaying the usual botanical collections accumulated in the Old World, the botanist of the Department received leave of absence the past summer for a visit to Europe, which was made without expense to the Department. Every facility was freely enjoyed of inspecting the immense collections at Kew, and in the British Museum, and of learning the most approved methods of preparing and arranging plants for study and reference. Profiting by these results of large experience, we may hope eventually to rival the results obtained by these world-renowned institutions.

THE LIBRARY.

The library has been increased during the year by the collection of eight hundred and fourteen volumes, obtained through exchanges and by purchase, many of which are rare and valuable; and one hundred volumes of periodicals, now ready for binding, with further additions yet to be made, will swell its total increase for the year to about one thousand volumes. Scientific and practical botany, hitherto inadequately represented in the library, is a prominent element in the accessions of the year. The operation of the system of foreign exchanges, so hopefully inaugurated, promising to furnish at a nominal cost the choicest productions of the foreign scientific and industrial press, especially that of Germany and France, has for several months been suspended in those nationalities by the existing war, while exchanges with other countries are increasing in number and importance.

THE DEPARTMENT GROUNDS.

The improvement of the grounds of the Department is steadily advancing toward completion in accordance with the original plan. A wall, appropriate in design and of sufficient strength, has been erected as a suitable and necessary support to the terrace walk in front of the building. This feature adds much to the appearance of that portion of the grounds, and when finished, with balustrades and other appendages, will form a proper finish and coincide with the style of architecture in the building.

The walks and roads are being completed and extended; all those of the western division of the front grounds are in course of construction. The covering of tar and asphalt concrete proves very suitable, when properly prepared and laid, for light roads and walks. Its marked cleanliness and freedom from vegetable growths are strong points in its favor, which command an increasing appreciation.

The planting of the arboretum of hardy trees and shrubs has been prosecuted as rapidly as the materials could be collected. Most of the plants yet to be procured are rare, and must be selected and imported from distant countries, a circumstance which necessarily retards the completion of the collection. When completed, this will prove a valuable addition to the working efficiency of the Department, and is already, even in its present state, attracting the attention and gaining the appreciation of scientific men.

THE NEW CONSERVATORY.

Under a system of rigid economy, the objects for which appropriations were made at the last session of Congress, viz, the erection of glass structures to be used in the propagation of economic plants, the improvement of the Department grounds, and the extension of the arboretum, have been attained; and the conservatory building, for which an appropriation of $25,000 was made, includes a grapery, not contemplated in the original plan; and the entire structure is perhaps unsurpassed in this country for utility and ornamental effect, and only excelled in Europe in one or two instances. The building was commenced about the 1st of August, and is now nearly finished, a large portion being already occupied. The main building is 320 feet in length, with an average width of 28 feet. The center compartment (60 by 30 feet) will be finished for the accommodation of the tall-growing tropical fruits, nuts, and palm trees. The two end buildings, 30 feet square, will be mainly devoted to the orange family and similar fruits, that require slight protection during the winter. The connecting wings will be used for the general collection of specialties. The grapery, directly in the center, and in the rear of the main building, a structure 150 feet in length and 26 feet in width, has been erected for cultivating and testing the best and most select varieties of foreign grapes. The adaptability of the climate and soil of the Pacific coast to this fruit is now fairly established, and the best varieties are objects of special inquiry.

The important object for which this is designed should not be overlooked or misunderstood. It is not intended for the cultivation of merely ornamental plants, though some attention will be given to them, so far as may be necessary to keep up a practical acquaintance with the improved flora of other countries, but will be occupied mainly for the propagation and experimental culture of all plants that may be utilized in the arts, in medicine, or in food supply, and which promise success in their introduction among the paying crops of the country.

There are few plants desirable for their economic value which may

not be produced in some sections of our continental domain; and the extent and cosmopolitan character of our immigration suggest, if not require, the greatest variety in production consistent with economy of labor and other peculiar circumstances of our condition. The progress of events shows that farmers and planters are alive to the necessity of such diversity; and this idea should be fostered and encouraged, as it is one of the most reliable indices of progressive civilization.

Among other species of valuable plants already in the collection may be mentioned the *Ipomœa purga*, producing the jalap; *Hura crepitans*, the sand box-tree; *Jatropha curcas*, a medicinal plant; *Bixa Orellana*, the arnotto plant; *Manihot utillissima*, the cassava; *Theobroma cacao*, the chocolate tree; *Andropogon Schœnanthus*, or lemon grass; *Elletaria Cardamomum*, the cardamom plant; *Amomum Melegueta*, a carminative; *Tamarindus Indica*, the tamarind tree; *Asclepias Curassacica*, a medicinal plant; *Cinchona*, of various preferred species, the Peruvian barks; *Sesamum Indicum*, famed for its oil products; *Abrus precatorius*, the Jamaica licorice; *Laurus Camphora*, the camphor plant; *Cinnamomum verum*, the cinnamon tree; *Acacia catechu; Mesua ferrea*, a medicinal plant; *Guilandina Bonduc*, an oil-bearing plant; *Piper Betel*, the betel plant; *Clusia flava*, the balsam tree; *Piper cubeba; Dorstenia Brasiliensis; Hæmatoxylon Campechianum, Dracaena Draco*, and *Pterocarpus Marsupium*, famed dye plants; *Croton Tiglium* and *Elacis Guineensis*, valuable oil-producing trees, with other medicinal species.

Of fruits, the various *Musas*, especially the *M. Cavendishii*, or dwarf banana; *Psidiums* or *Guavas*, so famed as a condiment; the *Mangosteen, Garcinia Mangostana;* the mamee apple, *Mamea Americana; Achras Sapota; Limonia Americana; Mangefera Indica*, the mango tree; *Chrysophyllum Cainito*, the West Indian star apple; *Papaya vulgaris*, the melon apple; *Monstera deliciosa; Nephelium Longanum; Anona Cherimolia*, the cherimoyer; *Anacardium occidentale*, cashew nut; *Phœnix dactylifera*, the date palm; *Bertholletia excelsa*, the Brazil nut, and the monkey cup nut, *Lecythis; Illicium floridanum*, the aniseed plant, and others of the pome and nut families.

The plants that furnish the various gums, dies, resins, oils, and fibers of commerce, are very numerous, and many species have not yet been introduced. Of the fibrous plants in the collection of the Department may be mentioned the *Musa textilis*, the Manilla hemp plant; various species of *Hibiscus* and *Ascepias, Bromelia*, and *Urtica*. The *Pæderia fœtida*, a new fiber plant recently brought into notice, has also been secured for trial. Those producing material for the manufacture of paper are specially worthy of trial and experiment. Conspicuous among utilizable plants is the extensive family of palms, so rich and varied in their products of food, medicine, and clothing. Of this extensive series but few have yet been added to the collection.

The distribution of seeds and plants of the China grass, *Bœhmeria nivea*, has afforded the opportunity to ascertain its proper culture and to become familiar with its growth, resulting in the conclusion that its cul-

ture can be successfully prosecuted whenever the perfection of machinery for its preparation may demand it. The jute plant, *Corchorus capsularis*, is also giving entire satisfaction as to growth and production.

It is believed that the profitable extension of production, by the contemplated introduction of new plants, and the enlarged culture of crops now yielding only partial supply of the home demand, such as sugar cane, rice, grapes, and semi-tropical fruits, and possibly tea to the extent of family supply in suitable latitudes, may increase the annual value of rural production to the extent of two hundred millions of dollars, thus accomplishing a revenue reform which would save to the country that magnificent sum in addition to the amount of import duties which would be collected upon such an importation.

Though such success should not be attained, there can be no doubt whatever that many new plants may be successfully acclimated, any one of which may exceed in value the total amount of all appropriations hitherto made to this Department.

DISTRIBUTION OF SEEDS.

The number of packages issued during eleven months of the year number 358,391, of which 133,043 were sent to members of Congress, 71,865 to agricultural societies, 71,400 to the corps of statistical correspondents, 7,960 to meteorological observers. The distribution includes seeds of cereals, grasses, hemp, jute, ramie, opium-poppy, sugar-beet, tobacco, sorghum, forest and shade trees, and many of the rarer species of plants oleaginous, edible, medicinal, and fibrous. The most abundant and convincing evidence of the great economic value of this distribution can be obtained from the archives of the Department, or gained from the sub-reports in recent annual volumes.

FINANCIAL.

The total amount expended by this Department since November 30, 1869, the date of my last report, is $169,175 24, under the following appropriations, to wit:

Compensation of Commissioner, clerks, and employés	$68,712 03
Collecting statistics and material for annual and monthly reports	14,206 51
Purchase and distribution of new and valuable seeds	20,739 31
Experimental garden, for labor, repairs, purchase of plants, &c	10,195 58
Contingencies—Stationery, freight, fuel, lights, for laboratory, museum, library, herbarium, keep of horses, &c	15,108 26
Improvement of grounds, (reservation No. 2)	16,017 79
Erection of glass structures for the cultivation of medicinal, textile, and economic plants	22,468 37
Miscellaneous	1,727 39
Total	169,175 24

Leaving a total balance unexpended of the appropriation for the current fiscal year of $107,370.

HORACE CAPRON,
Commissioner of Agriculture.

His Excellency U. S. GRANT, *President*.

REPORT OF THE SUPERINTENDENT OF GARDENS AND GROUNDS.

SIR: I have the honor to submit the following report on the progress of operations in the gardens and grounds of the Department:

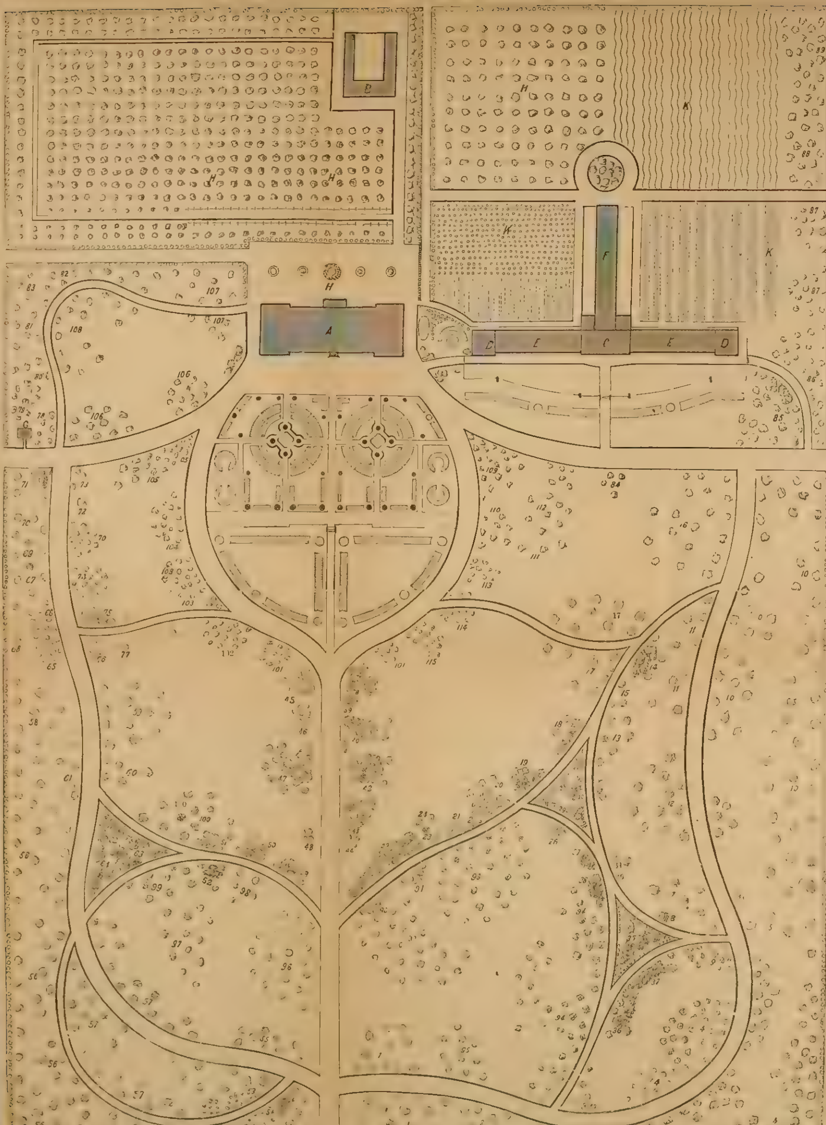
The planting of the arboretum has been prosecuted so far as the appropriations for the purpose would admit, in view of the difficulties attendant upon making so thorough and complete a collection as contemplated in the plan. The work of procuring plants for the special collections proposed for the green-houses has necessarily occupied much time and attention, and the comparatively slow progress of making these selections is readily accounted for, inasmuch as but few of the required plants are to be found in commerce, and have to be procured from their native habitats, or by exchange from collections attached to scientific institutions and botanic gardens in foreign countries. Valuable additions are constantly being received, and the collection is already of great variety and interest.

The accompanying plan of the grounds represents the position of the various genera of plants, and other details, which are indicated by figures and letters corresponding with the following

REFERENCES TO PLAN.

Betulaceæ.—1, Betula; 2, Alnus.
Salicaceæ.—3, Populus; 4, Salix.
Platanaceæ.—5, Platánus.
Juglandaceæ.—6, Juglans; 7, Carya; 8, Pterocarya.
Elæagnaceæ.—9, Elæagnus, Shepherdia, Hippophaë.
Cupiliferæ.—10, Quercus; 11, Castanea; 12, Fagus; 13, Carpinus; 14, Corylus; 15, Ostrya.
Tiliaceæ.—16, Tilia.
Magnoliaceæ.—17, Magnolia, Liriodendron, Kadsura, Schizandra.
Hypericaceæ.—18, Hypericum, Androsæmum.
Saxifragaceæ.—19, Philadelphus; 26, Deutzia; 27, Hydrangea, Decumaria; 28, Ribes, Itea.
Celastraceæ.—20, Euonymus, Celastrus.
Rosaceæ.—21, Rubus; 22, Spiræa; 23, Kerria; 24, Schizonotus; 25, Potentilla; 49, Cydonia; 50, Cotoneaster, Amelanchier; 86, Pyrus; 87, Cratægus; 88, Prunus; 89, Amygdalus, Amygdalopis.
Lythraceæ.—29, Punica, Lagerstrœmia.
Menispermaceæ.—30, Cocculus, Menispermum, Calycocarpum.
Lardizabalaceæ.—31, Akebia, Stauntonia.
Hamamelaceæ.—32, Hamamelis, Fothergilla, Liquidambar.
Anonaceæ.—33, Asimena.
Styracaceæ.—34, Styrax, Halesia, Symplocos.
Ericaceæ.—35, Gaylussacia, Vaccinium, Chiogenes, Arctostaphyios, Epigæa, Arbutus, Leucothoë, Cassandra, Cassiope, Andromeda, Oxydendron, Clethra, Phyllodoce, Pernettya, Kalmia, Daboecia, Menziesia, Azalea, Rhododendron, Rhodora, Ledum, Loiseleuria, Leiophyllum.
Berberidaceæ.—36, Mahonia; 37, Berberis.
Caprifoliaceæ.—38, Diervilla; 39, Symphoricarpus; 40, Lonicera; 41, Leycesteria; 42, Viburnum; 43, Sambucus.
Rubiaceæ.—44, Cephalanthus, Gelsemium.
Calycanthaceæ.—45, Calycanthus, Chimonanthus.

PLATE II.



PLAN OF THE DEPARTMENT GROUNDS.

Tamariscineæ.—46, Tamarix.
Cornaceæ.—47, Cornus, Benthamia, Nyssa, Garrya.
Araliaceæ.—48, Aralia, Hedera.
Malvaceæ.—51, Hibiscus.
Jasminaceæ.—52, Jasminum.
Oleaceæ.—53, Ligustrum, Olea, Chionanthus; 54, Syringa, Fontanesia, Forsythia; 55, Fraxinus, Ornus, Forestiera.
Sapindaceæ.—56, Æsculus, Staphylea, Kœlreuteria; 57, Acer, Negundo.
Urticaceæ.—58, Ulmus; 59, Morus, Maclura, Broussonetia, Ficus; 60, Celtis; 61, Planera.
Rhamnaceæ.—62, Rhamnus, Frangula, Sageretia, Berchemia, Zizyphus, Ceanothus, Paliurus.
Compositæ.—63, Baccharis, Iva, Artemisia.
Verbenaceæ.—64, Callicarpa, Vitex.
Asclepiadaceæ.—64, Periploca.
Leguminosæ.—65, Cytisus; 66, Laburnum; 67, Gleditschia; 68, Gymnocladus; 69, Cercis; 70, Robinia; 71, Genista, Sarothamnus, Ulex, Spartium, Ononis; 72, Cladrastis; 73, Albizzia; 74, Caragana; 75, Amorpha; 76, Wistaria; 77, Sophora, Colutea.
Anacardiaceæ.—78, Rhus, Pistacia.
Coriarieæ.—79, Coriaria.
Camelliaceæ.—79, Stuartia, Gordonia.
Simarubaceæ—80, Ailanthus.
Ebenaceæ.—80, Diospyrus.
Meliaceæ.—81, Melia.
Sterculiaceæ.—81, Sterculia.
Rutaceæ.—82, Zanthoxylum, Ptelea.
Bignoniaceæ.—83, Bignonia, Tecoma, Catalpa.
Scrophulariaceæ.—83, Paulownia, Buddlea.
Lauraceæ.—84, Laurus, Persea, Sassafras, Lindera, Tetranthera.
Aquifoliaceæ.—85, Ilex, Myginda, Nemopanthes.
Myricaceæ.—90, Myrica, Comptonia.
Thymeleaceæ.—91, Dirca, Daphne.
Coniferæ.—92, Pinus, (Ternatæ;) 93, Pinus, (Quinæ;) 94, Pinus, (Binæ;) 95, Larix, Pseudolarix; 96, Picea Bracteata; 97, Picea Brevebracteata; 98, Cedrus; 99, Sequoia, Sciadopitys, Cunninghamia; 100, Cryptomeria, Taxodium, Glyptostrobus; 101, Buxus; 102, Retinospora; 103, Biota, Thujopsis; 104, Cupressus; 105, Thuja, Libocedrus; 106, Abies, (Veræ;) 107, Tsuga; 108, Pinus, (Dubæ;) 109, Taxus; 110, Torreya, Cephalotaxus; 111, Salisburia; 112, Juniperus, (Oxycedrus;) 113, Saxe-Gothæa, Nageia, Araucaria; 114, Juniperus, (Sabinæ;) 115, Juniperus, (Cupressoides.)

A, Department building; B, Stabling and yard; C, Tropical fruit house; D, D, Houses for orange, lemon, and other semi-tropical fruits; E, E, Houses for miscellaneous collections of utilizable plants; F, House for collection of foreign grapes; G, Gate-house; H, Experimental orchards; K, Experimental grounds.

Some additions have been made to the plants in the arboretum, and the formation of roads and walks is steadily progressing as far as means will allow.

The glass structures were commenced toward the end of summer, and were so far completed by November as to admit the plants. The heating of the entire building could not be consummated, however; a portion only was made available for winter occupation. The structure is 320 feet in length on the east and west line, with a wing extending back

from the center of the main building 150 feet to the south. The front consists of a center pavilion, 60 feet long, 32 feet wide, and 30 feet in extreme height; two end pavilions, each 30 feet square and 26 feet in height, connected by wings, each 100 feet in length, 25 feet in width, and 17 feet extreme height. Ventilation is provided by hinged sashes on the upright portion of the lantern which surmounts the roof. These are arranged so as to admit air and exclude rain, a very desirable provision in the management of all kinds of plant structures. The center apartment is designed for the reception of palms and other large-growing tropical plants that may be necessary in the collection, which is contemplated to be strictly economic and utilizable. The two end pavilions will be occupied by the orange family and other semi-tropical fruits, and plants of tall growth. The connecting wings are arranged for the miscellaneous collections of plants now being secured.

The grapery has been planted with an assortment of foreign grapes. The borders for their growth are prepared solely on the outside of the walls, and the stems of the plants introduced through openings made in the brick-work. The border was prepared by running a drain 15 feet from the house and parallel with it. From this main, cross-drains were dug 10 feet apart, thus insuring perfect drainage. The soil was then deeply spaded, covering in and mixing with it a good dressing of rotted manure. The object being to produce a healthy and properly matured growth, an excessively rich border was avoided to begin with; when it is found necessary, the soil can be enriched by surface-manuring. The vines are planted three feet apart, being fifty on a side, altogether comprising one hundred varieties, the dark and rose-colored kinds being on one side, and the light-colored on the other.

The heating is effected by hot water circulating in iron pipes. About 5,000 feet of four-inch piping will be required for the entire structure. Two boilers have been set in place for heating the water. Stop-valves are introduced, so that the boilers may work independently of each other, or in combination, as may be desired. Each apartment can also be heated independently of the others, thus affording every facility for the practical application of heat to suit the habits of the plants.

The external appearance of these houses is much admired. They are well proportioned, and present a pleasing architectural effect, which is not produced at the expense of their adaptability to the healthy growth of plants. They are also substantially built, the foundation walls being of red sandstone, with base and caps of rubbed bluestone, forming a good contrast. The windows and doors of the pavilions are finished with ornamental Moresque arches, springing from the caps of the light intermediate pilasters. These arches are parted from each other by molded brackets supporting the main cornice, behind which the glazed cupola roof rises. The lanterns above the curved roof are arranged with movable sashes for ventilation. The main entrance projects boldly from the mass of the building, with three arched openings, which are surmounted by a graceful pediment.

The frame of the structure is painted in different shades of buff, with the sash-bars laid in pearl color. The ornamental ridge imparts a light appearance to the monotonous roof line, and the characteristic feature of the decorations consists in their judicious application to the constituent elements of the construction, instead of constructing superfluous work for the purpose of mere decoration.

These houses are covered on what is now known as the fixed-roof mode. The sash bars are set for 12-inch glass, which is carefully bedded in putty, and firmly secured in place by brad-nails; no putty is used

externally. A month or so after glazing, when the putty has had time to dry and shrink, the wood-work is painted, and all the openings from shrinkage carefully filled with paint; only in this way can perfectly water-tight glazed roofs be secured. The roof is covered with the best quality of double-thick American glass, which was manufactured and curved expressly for the purpose.

GRASSES.

In the Report for 1869 a record was given of the growth and characteristics of certain named grasses. The growth of the past season furnishes additional information regarding their permanency, especially as regards resistance to droughts, and their endurance when subjected to scorching sun and parched soil. The following list embraces those species that have proved best in this respect, viz: *Aira flexuosa*, *Agrostis stolonifera*, *Agrostis alba*, *Bromus pratensis*, *Cynosurus cristatus*, *Festuca pratensis*, *Festuca ovina*, *Festuca duriuscula*, *Festuca rubra*, *Festuca tenuifolia*, *Hordeum bulbosum*, *Lolium Italicum*, *Poa pratensis*, and *Poa aquatica*. While all of these appear to stand equally well during summer, the *Agrostis*, *Aira*, and *Cynosurus* become somewhat browned after frost in early winter. The *Festucas* are conspicuously green and verdant-looking all the year round; the *Poas* also maintain a good color. The last two named genera are possessed of very fine leaves, and naturally of a thick, spreading habit of growth, which, together with their other qualifications, render them particularly adapted to the formation of lawns, and perhaps no grasses at present known can supersede them for that purpose. If confined to either one, the *Poa* species should, for various reasons, receive the preference.

The excellent qualities of *Lolium Italicum*, the Italian rye-grass, and its rapid growth, especially in irrigated meadows, have been the means of directing attention to its merits as a forage plant in localities where extreme droughts and heat prevent the proper maturation of tardy growing species. In the Southern States, where it is found difficult to secure a hay-crop from timothy, (which is considered the best grass for this purpose,) it has been suggested that by sowing Italian rye-grass in the fall, after the dry season has passed, a crop might be secured the next year before the severe hot and dry weather should prevail. To test this matter of growth during winter, sowings of the common perennial rye-grass and the Italian rye-grass were made about the middle of October. The weather proving dry for several weeks afterward, the young plants made slow progress. The winter was rather severe, but, notwithstanding that no covering or protection was given, the Italian measured 18 inches in average length on the 28th of April; the perennial measured 10 inches average length.

TEA. (*Thea viridis.*)

The demand for tea-plants having increased very considerably of late, special attention has been given to their propagation. In the absence of seeds, which are not always readily procured from Japan or from China in condition for germination, the stock of young plants has been derived from cuttings of the partially matured growths. taken off early in autumn. These form roots in the course of six weeks or two months, when planted in sand and kept in a warm greenhouse, without any further appliance of heat. Plants have also been secured from cuttings of the tender growths taken in May, but to be successful with these it is necessary to place them in a hot-bed, and guard them against evaporation. About ten years ago a small plant was transferred to a

border in the garden, where it has remained and made a healthy yearly growth without the slightest protection either in summer or winter. During severe winters the points of the shoots become browned, but they speedily recover when spring growth commences. From this plant many thousands of young ones have been produced and distributed, principally in the Southern and Southwestern States. It blooms quite profusely in the fall months, but too late to mature seeds. The flowers are fragrant, and as a greenhouse plant it is quite as meritorious as many of those usually found in these structures.

The want of fresh seeds is no longer felt, as many of the plants first sent out produce them in abundance in South Carolina and other States, and can be supplied in quantities sufficient to meet all reasonable demands for plants required solely for purposes of experiment.

Botanists recognize only one species of *Thea*, the *T. Bohea* being regarded simply as a variety; and it is well known that the commercial brands of tea refer either to the place of growth, or modes of manufacture and preparation for market. There is high probability, however, that this plant, so long in cultivation and under conditions of soil and climate so varied, may have run into many varieties of more or less constancy, but there is nothing authentic on the subject. The recent importations, by the Department, of tea-seeds from various parts of China, Japan, and Assam, may develop facts bearing on these points.

NEW ZEALAND FLAX.

An invoice of seeds of the *Phormium tenax*, or New Zealand flax, has recently been received, and they are apparently in good condition. On several previous occasions seeds of this plant have been placed in my hands, but either from being imperfectly ripened when gathered, or from loss of vitality during their transmission to this country, they failed to germinate. Those lately received appear to be in better condition than any heretofore imported, and hopes are entertained that they will germinate, and assist in the increase of the present limited stock of this promising and useful plant.

It has long been known that this plant possesses a very strong fiber. It is mentioned in the narratives of the earlier navigators to New Zealand that they found the fiber in common use among the natives, from which they made various articles of clothing, ropes, nets, &c., even strips of the green leaves, without preparation of any kind, being used as cords and strings for domestic purposes. The strength and tenacity of the fiber are such as to render it worthy of notice, being supposed to compare favorably with the best vegetable productions of like character. Experiments made by De Candolle to test its strength as contrasted with silk, and with some other well-known vegetable fibers, resulted as follows: Silk supported a weight of 34; New Zealand flax, $23\frac{4}{5}$; common hemp, $16\frac{3}{4}$; common flax, $11\frac{3}{4}$; pita fiber, 7.

While it is well known that the leaves of this plant contain a valuable fiber, it has not hitherto been profitably prepared for the manufacturer. As is the case in regard to the China grass plant, there appears to be considerable difficulty in divesting it of extraneous substances. In this plant the fiber is incorporated with a quantity of gummy matter, which presents a practical difficulty in its preparation for the spinner and paper manufacturer. That excellent cordage can be made from it, as also very fine paper, has been frequently shown, and it is probable that if the attention of practical investigating chemists could be directed to the importance and value of researches on the leaves of this plant, modes of preparation would be discovered that would obviate all objections,

and enable paper-makers and others to avail themselves of this valuable fiber.

As bearing upon the practicability of its cultivation in this country, it may be stated that in New Zealand it is found in greatest abundance in alluvial bottom-lands, near the sea-coast and the margins of rivers; and it has been growing for many years in the open air, both in France and Great Britain, and is rarely injured, even slightly, by the severest frosts of those climates.

CHINA GRASS.

Some confusion appears to exist concerning the species of *Bœhmeria* now in cultivation in some of the Southern States, and as it was deemed a matter of considerable moment to planters about to engage in its culture, that some definite conclusions should be established in regard to it, the Department made efforts to procure seeds and plants from various sources. Seeds were procured from France, under the names of *B. nivea* and *B. candicans*, and from Japan by direct importation; also a package from a private source, said to have been procured in China, and labeled China grass. All these produced plants exactly alike, and are referred to *B. nivea*, var. *candicans*. Plants received from Japan, as also all the plants heretofore cultivated in Washington, prove to be the same as those named above. Plants received from a cultivator in Mississippi prove to be the true *B. nivea*.

Description.

Bœhmeria nivea.—Stems downy, with pubescent hair; leaves cordate truncate, oval, tapering into a scythe-shaped point, broadly crenate, toothed, pubescent both sides; nerves prominent, reticulated feather-veined; green, between nerves underneath; height about two feet.

Bœhmeria nivea, var. *candicans*.—Stems closely covered with pubescent hair; leaves cordate truncate, broadly ovate, broadly crenate, toothed, tapering to a straight point, greenish above, densely white, woolly under the whole leaf; nerves prominent, intersected with mostly parallel nerves; height about three feet.

The variety appears to be the stronger-growing plant; and from its frequent occurrence, both in imported seeds and China grass plants, it would seem to be the kind most generally recognized as furnishing this fiber. So far as regards the quality of fiber, there is probably not a shade of difference, and as to quantity, the more robust plant will evidently take precedence.

A plant received from Missouri, under the name of northern ramie, proved to be *Urtica chamædryoides*, a native species growing from 3 to 4 feet in height. A plant received from Texas, said to be superior to ramie, proved to be a species of *Malachra*, a Malvaceous plant, possessing a strong fiber.

ESPARTO GRASS.—*Stipa tenacissima*, L.; *Macrochloa tenacissima*, Kth.

After many abortive attempts to secure either plants or seeds of the so-called Esparto grass, the Department ultimately succeeded in securing from France a small quantity of the seeds. These came to hand about the middle of summer, and it not being deemed advisable to sow them in the open ground at that season, a portion was planted in boxes, which were placed in a shaded green-house, where the atmospheric moisture could be properly regulated. Under these conditions about 10 per cent. of the seeds germinated. About the 1st of October a further sowing was made in a large glass-covered frame. A few plants made their appearance, which were covered slightly with leaves during winter,

to guard them against injury from the freezing and thawing of the soil, which act so injuriously upon young and feeble-rooted plants.

The remainder of the seeds were sown in the experimental grounds in March, and in due time vegetated in about the same proportions as the first sowing. During summer the ground was mulched between the plants; they progressed favorably, and stood the winter uninjured.

The plant seems to be of rather slow growth, and, although it is described as inhabiting poor, arid soils, that cannot support any other vegetation, it appears from the growth here that a damp soil gives a much stronger and healthier plant.

EUCALYPTUS.

The rapidity of growth of the *Eucalyptus*, of New South Wales, and its supposed adaptability to flourish in very dry and austere climates, has led to frequent inquiries by those who are interested in the laudable purpose of raising forests on the treeless plains of the West.

That most of the species of *Eucalyptus*, as well as many of the genus *Acacia*, grow with great rapidity, is a well-known fact; but neither of them will stand 10° of frost during winter. And as to their growing fast in a dry climate, it should be remembered that the season of active growth in their native country is characterized by heavy continued rains, and a consequent moist atmosphere. The period of extreme dryness to which they are subjected is their period of rest, corresponding to our winter. On the Pacific coast these trees have been cultivated for many years, and are now largely used as shade-trees in cities.

A species of *Eucalyptus*, *E. globulus*, the blue gum-tree, has lately attracted some attention for its supposed medical value, and statements have been made to the effect that it contains properties similar to those of the cinchona. For the purpose of furthering the prosecution of experiments, if it is deemed desirable, a number of plants have been propagated for dissemination.

In connection with the subject of selecting trees for their rapidity of growth and suitableness for dry and exposed localities, it may be stated that there is no scarcity of plants that are known to possess all these requisites. For rapidity of growth the native poplars are not surpassed by any species of trees indigenous to temperate climates. The ailanthus has been proved to succeed well on dry and comparatively barren soils, and the wood has a reputation for great permanence for fence-posts and for similar domestic purposes. It may be hinted that the supposed difficulty of clothing the western plains with trees has been very much overstated; when the same care is taken to produce a crop of trees as is taken to produce a crop of corn, it is attended with success, as has been abundantly proved by experiment in these outlying lands.

The feasibility of producing a growth of timber on the most exposed and bleak situations, as well as in localities where a dearth of moisture prevents the cultivation of grain crops, has been repeatedly confirmed. Let the natural vegetation be of the most humble character, even if only the smallest herb or shrub can find a foothold, then a nucleus is already established for larger growths. The first requirements are shelter, protection, and amelioration of climate; therefore the quality and value of timber are but secondary; where foliage of any kind can be secured, the climatic surroundings are improved and fitted for the growth of valuable timber-trees, which, in turn, afford the necessary protection for fruit-trees and vines, as well as all other cultivated crops suited to the zone of growth.

RASPBERRIES.

Many of the apparent discrepancies in the results of raspberry culture, and the conflicting opinions upon the merits of varieties, arises from a want of a thorough discrimination of the species from which they have been obtained, and the special treatment that they respectively require.

Taking the Philadelphia as a type of our native species, we have a plant that has proved healthy and productive, almost without exception, wherever it has been planted, and therefore it has become somewhat popular, although, when compared with varieties of the foreign species, the fruit is inferior in size, quality, and appearance, affording another instance where vigor of growth and productiveness give a superlative value, even when the quality of fruit is decidedly inferior, as exemplified by the Albany Seedling among strawberries and the Concord among native grapes.

Taking the Red Antwerp as an example of the foreign varieties of the raspberry, we find a vast difference in the opinions of cultivators with regard to its success. In some localities it is highly extolled, while in many others it is as decidedly condemned. That there are good reasons for these opposite opinions there can be no doubt, and observations prove that failures are caused by the great heat and dryness of our climate during summer, which arrests the growth of the plants and prevents their proper maturity.

The measure of success attending the culture of the foreign varieties of the raspberry depending so much upon a proper degree of moisture, it is evident that in light sandy and gravelly soils failures will be the rule; when planted in more retentive and clayey soils, growth will be more continuous and a healthier vegetation be secured.

Keeping these facts in view, the special treatment required to meet the various influences of particular soils and localities will readily be suggested.

With regard to localities, it would appear that in the Southern States, where the weather is dry and warm during the latter portion of summer, these varieties will be unfitted to the climate, and only productive under the constant attention to such culture as tends to modify these antagonistic conditions to success; and experience fully bears out this conclusion. Again, in regard to soils, where it is unavoidable to plant on dry soils, the whole of the surface surrounding the plants should receive a heavy mulching during summer. Where this is persistently practiced, remunerative crops may be produced even in southern localities.

On clay soils, provided they are properly drained, surface-stirring, so as to keep a loose, comminuted surface; mulching may be dispensed with, but even on these soils it may prove of great advantage in the dryest seasons to spread a thin coating of leaves or strawy manure over the roots of the plants. The special object to keep in view is that of constantly maintaining the soil in a condition that will encourage growth during summer, and secure the unchecked maturity of the canes for fruiting the following year. Covering the canes during winter, although a wise precaution, and profitable always, will not in itself secure a crop of fruit from unripened wood; hence those who depend altogether upon the covering process, are frequently subjected to disappointments.

WILLIAM SAUNDERS,
Superintendent of Gardens and Grounds.

Hon. HORACE CAPRON,
Commissioner.

REPORT OF THE STATISTICIAN

SIR: I have the honor to present my sixth annual report as Statistician of the Department of Agriculture. The estimates of crops of 1870 are based upon the census returns of the previous year, as far as they have been available; but the tabulation of a considerable portion of those returns not being yet complete, the comparison of 1870 has been completed with our own estimates of 1869. This unchanged basis is used for most of the Southern States, and for a few of the Western. As the census schedules provide only for enumeration of domestic animals on farms, an estimate of farm animals in cities and stock-yards has also been included, as well as large numbers pastured on public lands, especially in the Pacific States and in the Territories. Less than half the cattle and sheep of the Territories are returned by marshals under the present census law.

CROPS OF 1870.

Corn.—An increased breadth of corn was planted in some of the Southern States, and in nearly all of the Western. The conditions for germination and early growth were generally favorable, and the prospect for a harvest in June and July was reported good in New England and in the Middle States, while in the Western States the indications of a large crop were general. Wet weather in the Carolinas obstructed cultivation and delayed the destruction of a rank growth of weeds, detracting somewhat from the promise made by a strong growth and good color; and in parts of the Gulf region the crop, though vigorous, was not well advanced at this date, having been delayed by late planting or replanting of wet lands.

In September it was officially stated that corn had been injured in localities by drought, by wet weather, by worms, and by early frosts, but not sufficiently to threaten a material reduction of the expected aggregate. Almost every State made returns of high condition. In October it was evident that the corn crop would prove a full one, probably the best in ten years, and much larger than those of the two years preceding. The States reporting less than the average were New Hampshire, Massachusetts, Connecticut, Delaware, Maryland, Kansas, Nebraska, California, and Oregon, the other States ranging from 2 per cent. to 22 above an average. The crop ripened unusually early, without injury from frosts, and is remarkably sound, with exceptions of injury from drought, as in Eastern Massachusetts, where some fields were cut up for fodder; in Virginia, where the product of valleys, overwhelmed by floods, was rendered unfit for use by man or beast; and in small sections of the South, and of the Missouri Valley, where the quality was injured by excessive rains.

Winter grains.—The opening of spring presented the winter wheat and rye in a weak and unthrifty condition, in comparison with the luxuriance of the previous spring, which foretold the great crop of 1869. Exposure to ice and freezing winds had reduced vitality in spots and patches liable to the injury of winter-killing, while well drained areas presented plants which were small, but vigorous, of good color, and ready to start into healthful growth under the influence of a genial spring. With exceptional cases of severe freezing, the actual destruction of the plant was by no means sweeping. The backwardness of growth was mainly caused by late planting, followed by an early winter,

which allowed of little more than germination before cold weather set in. Mild weather and light snows, accompanied with few sudden changes, prevailed in early winter, while the colder and rougher weather of later winter was attended with heavier snows, which furnished valuable protection and relieved the severity of the winter-killing. The amelioration produced by the favorable weather of May was general, and in places quite marked, brightening the promise of a moderately abundant harvest. In June the principal wheat-growing States made returns of condition of winter wheat varying from 6 to 24 per cent. below an average. The Southern States presented a more favorable showing than usual. The condition of spring wheat was also under an average. The superiority of the early-sown winter wheat, manifested so prominently in spring, was maintained as the season advanced; in deep and mellow soils, even with a high temperature and drought, it presented a vigorous appearance and well filled heads, though the straw might be somewhat shortened. The drill-seeded fields invariably made a finer show than those sown broadcast. Among the casualties reported were rust, which had a limited range; hail-storms, especially prevalent in the Ohio Valley; driving rains, in Virginia and North Carolina; grasshoppers, in Utah; and squirrels, in Contra Costa County, California, where their destruction of wheat, "by the acre daily," called forth public assemblies to repel the invaders, the losses being estimated at $100,000.

In July the estimated reduction in acreage, as compared with the crop, was 6 per cent., and in condition 13 per cent. The final returns in October indicated the yield which appears in our tables, the comparison being made with the census returns of the crop of 1869. Every prominent wheat-producing State exhibited a reduction ranging from 2 to 18 per cent.

The Tappahannock appeared to be most prominent among varieties succeeding well, particularly in the South and West and Utah Territory.

Hay.—The season was favorable for this crop in the State of New York, on the western slope of the Alleghanies, and on the Pacific coast, and the product was large in those sections. In New England, New York, and in the Ohio Valley, and west of the Mississippi, a material reduction in the yield appears. The quality, as a whole, was above medium.

Potatoes.—The yield of this important esculent was under an average in all the Atlantic States southward to Virginia, and in all the Western States north of the Ohio River, the depreciation ranging from 15 to 44 per cent. An average crop was obtained in Virginia, Kentucky, Tennessee, and Arkansas. A slight reduction was experienced on the Pacific coast. The potato beetle, *Doryphora decemlineata*, extended its theater of operations to the Ohio line, and committed great devastations on his eastward march, not forgetting to leave detachments to occupy in future the country already conquered. Drought caused much loss, both east and west.

Cotton.—The spring and early summer were more favorable than in 1869, though there was complaint of "bad stands" in South Carolina, of drought for five weeks in Georgia, of a less extended season of dry weather in Alabama, and of a late and unpropitious start in Texas; yet it was a general fact that vigor and thrifty growth were offset by as few local drawbacks as could be expected, even in the average of good seasons. An increase of acreage was exhibited in the July returns, estimated at 12 per cent. above that of the previous year, assumed to repre-

sent about 1,000,000 acres. The condition of the plant in July was high in Georgia, Alabama, Louisiana, and Arkansas; barely medium in the Carolinas, Florida, Mississippi, Texas, and Tennessee. There had been too much rain in the Carolinas, heavy rains in Georgia had done some damage, and storms in several counties in Mississippi had retarded growth; yet the plant was almost everywhere thrifty, a rapid growth set in, and it soon became evident that, with an auspicious autumn, a large crop would be produced, and the possibility of a product of 4,000,000 bales was foreshadowed. In September the prospect was equally favorable, notwithstanding some accounts of rust, worms, &c., from which no season is entirely exempt. Upon receipt of returns to November 1, the usual date for the recurrence of killing frost, an estimate of 3,800,000 bales was calculated; but the continued high temperature, growth, and maturation of bolls, and unexampled weather for picking, by which the work was successfully extended into January, added a full half million bales to the expected crop. The result proved the estimate to be a very reasonable one. Had the cotton season been one of medium length, an estimate of 4,000,000 bales would have proved quite too high. Unlike corn and other farm crops, cotton, being a perennial, continues to produce new flowers and fruit in undiminished measure, until the plant is killed by frost.

Table showing the product of each principal crop of the several States named, the yield per acre, the total acreage, the average price in each State, and the value of the crop, for 1870.

Product.	Amount of crop of 1870.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
MAINE.					
Indian corn ....bushels..	1, 198, 000	33	36, 303	$1 14	$1, 365, 720
Wheat ....do....	264, 000	14. 8	17, 837	1 78	469. 920
Rye ....do....	32, 000	17. 6	1, 818	1 38	44. 160
Oats ....do....	2, 163, 000	27. 4	78, 941	65	1, 405. 950
Barley ....do....	586. 000	19. 5	30, 051	99	580. 140
Buckwheat ....do....	443, 000	24	18, 458	75	332, 250
Potatoes ....do....	6, 527, 000	125	52, 216	66	4, 307, 820
Tobacco ....pounds..	....	....	....	....	....
Hay ....tons..	821, 000	.80	1, 026, 250	19 69	16, 165, 490
Total	....	....	1, 261, 874	....	24, 671, 450
NEW HAMPSHIRE.					
Indian corn ....bushels..	1, 213, 000	36. 5	33. 232	1 09	1, 322, 170
Wheat ....do....	174. 000	14. 8	11, 756	1 59	276, 660
Rye ....do....	43, 000	16	2, 687	1 24	53, 320
Oats ....do....	1, 066, 000	29. 7	35, 892	66	703, 560
Barley ....do....	96, 000	21. 5	4, 465	1 07	102, 720
Buckwheat ....do....	87, 009	15	5, 800	83	72. 210
Potatoes ....do....	2, 980, 000	88	33, 863	79	2, 354, 200
Tobacco ....pounds..	150. 000	1,000	150	22	33, 000
Hay ....tons..	520, 000	.96	541, 666	19. 85	10, 322, 000
Total	....	....	669, 511	....	15, 239, 840
VERMONT.					
Indian corn ....bushels..	1, 920, 000	39. 6	48, 484	1 10	2, 112, 000
Wheat ....do....	409, 000	16. 8	24, 345	1 63	666, 670
Rye ....do....	67, 000	15. 8	4, 240	1 15	77, 050
Oats ....do....	3, 170, 000	33. 7	94, 065	59	1, 870, 300
Barley ....do....	107, 000	23. 3	4, 592	1 01	108. 070
Buckwheat ....do....	336. 000	17. 5	19, 200	75	252. 000
Potatoes ....do....	4, 899, 000	140	34, 992	51	2, 498, 490
Tobacco ....pounds..	70, 000	1050	66	22	15, 400
Hay ....tons..	979, 000	.96	1, 019, 791	14 50	14, 195, 500
Total	....	....	1, 249, 775	....	21, 795, 480

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1870.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
MASSACHUSETTS.					
Indian corn.....bushels..	1, 327, 000	33	40, 212	$0 98	$1, 300, 460
Wheat.....do....	35, 000	17. 6	1, 988	1 75	61, 250
Rye.....do....	232, 000	15. 4	15, 064	1 10	255, 200
Oats.....do....	733, 000	26. 4	27, 765	73	535, 090
Barley.....do....	126, 000	20. 7	6, 086	1 08	136, 080
Buckwheat.....do....	38, 000	14	2, 714	1 02	38, 760
Potatoes.....do....	2, 208, 000	88	25, 090	96	2, 119, 680
Tobacco.....pounds..	6, 289, 000	1350	4, 658	24	1, 509, 360
Hay.....tons..	507, 000	1. 07	473, 831	26 14	13, 252, 980
Total.....	.....	.....	597, 408	.....	19, 208, 860
RHODE ISLAND.					
Indian corn.....bushels..	280, 000	26	10, 769	1 06	296, 800
Wheat.....do....	700	17. 6	39	1 75	1, 225
Rye.....do....	20, 600	18	1, 144	1 27	26, 162
Oats.....do....	152, 000	32. 7	4, 648	61	92, 720
Barley.....do....	30, 000	24	1, 250	96	28, 800
Buckwheat.....do....	1, 400	14	100	1 02	1, 428
Potatoes.....do....	488, 000	79	6, 177	98	478, 240
Tobacco.....pounds..	.....	.....	.....	.....	.....
Hay.....tons..	89, 000	1. 09	81, 651	24 00	2, 136, 000
Total.....	.....	.....	105, 778	.....	3, 061, 375
CONNECTICUT.					
Indian corn.....bushels..	1, 413, 000	26. 4	53, 522	1 14	1, 610, 820
Wheat.....do....	38, 000	17. 8	2, 134	1 52	57, 760
Rye.....do....	289, 000	14. 4	20, 069	1 16	335, 240
Oats.....do....	913, 000	32. 4	28, 179	69	629, 970
Barley.....do....	24, 000	26. 5	905	1 02	24, 480
Buckwheat.....do....	96, 000	14	6, 857	1 05	100, 800
Potatoes.....do....	1, 729, 000	73	23, 684	99	1, 711, 710
Tobacco.....pounds..	7, 495, 000	1, 250	5, 996	22. 6	1, 693, 870
Hay.....tons..	433, 000	1. 30	333, 076	25 60	11, 084, 800
Total.....	.....	.....	474, 422	.....	17, 249, 450
NEW YORK.					
Indian corn.....bushels..	19, 426, 000	34	571, 352	87	16, 900, 620
Wheat.....do....	9, 133, 000	13. 8	661, 811	1 41	12, 877, 530
Rye.....do....	2, 230, 000	13	171, 538	97	2, 163, 100
Oats.....do....	29, 646, 000	32. 4	915, 000	58	17, 194, 680
Barley.....do....	6, 616, 000	21. 2	312, 075	85	5, 623, 600
Buckwheat.....do....	3, 435, 000	17. 9	191, 899	81	2, 782, 350
Potatoes.....do....	25, 121, 000	98	256, 336	65	16, 328, 650
Tobacco.....pounds..	2, 584, 000	1, 100	2, 349	20	516, 800
Hay.....tons..	4, 491, 000	1. 23	3, 651, 219	17 21	77, 290, 110
Total.....	.....	.....	6, 733, 579	.....	151, 677, 449
NEW JERSEY.					
Indian corn.....bushels..	10, 057, 000	33	304, 757	81	8, 146, 170
Wheat.....do....	1, 680, 000	12. 8	131, 250	1 43	2, 402, 400
Rye.....do....	470, 000	13. 4	35, 074	97	455, 900
Oats.....do....	4, 019, 000	31	130, 612	54	2, 186, 460
Barley.....do....	7, 000	28	250	1 10	7, 700
Buckwheat.....do....	311, 000	24. 3	12, 798	1 00	311, 000
Potatoes.....do....	3, 858, 000	75	51, 440	94	3, 626, 520
Tobacco.....pounds..	40, 000	1, 150	34	23	9, 200
Hay.....tons..	553, 000	1. 40	395, 000	19 44	10, 750, 320
Total.....	.....	.....	1, 061, 215	.....	27, 895, 670

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1870.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
PENNSYLVANIA.					
Indian corn .... bushels..	38, 866, 000	35. 8	1, 085, 642	$0 75	$29, 149, 500
Wheat .... do....	17, 115, 000	12	1, 426, 250	1 27	21, 736, 050
Rye .... do....	3, 148, 000	12	262, 333	89	2, 801, 720
Oats .... do....	34, 289, 000	32. 6	1, 051, 809	48	16, 458, 720
Barley .... do....	497, 000	23. 9	20, 794	91	452, 270
Buckwheat .... do....	2, 278, 000	18	126, 555	85	1, 936, 300
Potatoes .... do....	11, 084, 000	87	127, 402	78	8, 645, 520
Tobacco .... pounds..	3, 294, 000	1, 200	2, 745	21	691, 740
Hay .... tons..	2, 734, 000	1. 30	2, 103, 076	13 05	35, 678, 700
Total	....	....	6, 206, 606	....	117, 550, 520
DELAWARE.					
Indian corn .... bushels..	3, 311, 000	25	132, 440	65	2, 152, 150
Wheat .... do....	626, 000	10	62, 600	1 25	782, 500
Rye .... do....	10, 000	11. 2	892	83	8, 300
Oats .... do....	498, 000	20	24, 900	50	249, 000
Barley .... do....	1, 700	20	85	92	1, 564
Buckwheat .... do....	1, 300	20	65	1 00	1, 300
Potatoes .... do....	217, 000	75	2, 893	1 00	217, 000
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons..	37, 000	1	37, 000	20 00	740, 000
Total	....	....	260, 875	....	4, 151, 814
MARYLAND.					
Indian corn .... bushels..	11, 818, 000	22. 5	525, 244	0 71	8, 390, 780
Wheat .... do....	4, 792, 000	9. 7	494, 020	1 28	6, 133, 760
Rye .... do....	264, 000	10. 5	25, 142	78	205, 920
Oats .... do....	3, 286, 000	24	136, 916	47	1, 544, 420
Barley .... do....	10, 700	22	486	90	9, 630
Buckwheat .... do....	67, 000	13. 5	4, 962	1 11	74, 370
Potatoes .... do....	897, 000	67	13, 388	90	807, 300
Tobacco .... pounds..	14, 522, 000	637	22, 797	08. 6	1, 248, 892
Hay .... tons..	232, 000	1. 22	190, 163	16 33	3, 788, 560
Total	....	....	1, 413, 118	....	22, 203, 632
VIRGINIA.					
Indian corn .... bushels..	19, 360, 000	20	968, 000	65	12, 584, 000
Wheat .... do....	6, 705, 000	9. 6	698, 437	1 24	8, 314, 200
Rye .... do....	519, 000	9. 6	54, 062	73	378, 870
Oats .... do....	7, 175, 000	19. 5	367, 948	42	3, 013, 500
Barley .... do....	7, 000	20	350	80	5, 600
Buckwheat .... do....	44, 000	16	2, 750	70	30, 800
Potatoes .... do....	1, 236, 000	55	22, 472	71	877, 560
Tobacco .... pounds..	43, 761, 000	739	59, 216	07. 3	3, 194, 553
Hay .... tons..	216, 000	1. 38	156, 521	14 72	3, 179, 520
Total	....	....	2, 329, 756	....	31, 578, 603
NORTH CAROLINA.					
Indian corn .... bushels..	22, 500, 000	14. 6	1, 541, 095	78	17, 550, 000
Wheat .... do....	4, 218, 000	8. 6	490, 465	1 21	5, 103, 780
Rye .... do....	400, 000	8. 3	48, 192	97	388, 000
Oats .... do....	2, 750, 000	16. 2	169, 753	57	1, 567, 500
Barley .... do....	2, 000	22	90	61	1, 220
Buckwheat .... do....	17, 800	21. 4	831	58	10, 324
Potatoes .... do....	742, 000	81	9, 160	70	519, 400
Tobacco .... pounds..	30, 000, 000	586	51, 194	14. 1	4, 230, 000
Hay .... tons..	169, 000	1. 40	120, 714	11 47	1, 938, 430
Total	....	....	2, 431, 494	....	31, 308, 654

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1870	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
SOUTH CAROLINA.					
Indian corn .... bushels..	12,000,000	8.9	1,348,314	$1 06	$12,720,000
Wheat .... do....	1,012,000	7	144,571	1 89	1,912,680
Rye .... do....	60,000	5.8	10,344	1 70	102,000
Oats .... do....	926,000	9.7	95,463	84	777,840
Barley .... do....	7,000	15	466	95	6,650
Buckwheat .... do....	....	....	....	....	....
Potatoes .... do....	113,000	48	2,354	1 15	129,950
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons..	74,000	1	74,000	21 66	1,602,840
Total	....	....	1,675,512	....	17,251,960
GEORGIA.					
Indian corn .... bushels..	31,000,000	13.5	2,296,296	90	27,900,000
Wheat .... do....	2,387,000	8	298,375	1 47	3,508,890
Rye .... do....	100,000	8.1	12,345	1 49	149,000
Oats .... do....	1,260,000	14.6	86,301	83	1,045,800
Barley .... do....	12,000	15	800	97	11,640
Buckwheat .... do....	....	....	....	....	....
Potatoes .... do....	350,000	78	4,487	1 34	469,000
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons..	55,000	1.34	41,044	23 33	1,283,150
Total	....	....	2,739,648	....	34,367,480
FLORIDA.					
Indian corn .... bushels..	2,247,000	10.8	208,055	1 35	3.033,450
Wheat .... do....	....	....	....	....	....
Rye .... do....	....	....	....	....	....
Oats .... do....	116,400	12.5	9,312	1 00	116,400
Barley .... do....	....	....	....	....	....
Buckwheat .... do....	....	....	....	....	....
Potatoes .... do....	10,000	75	133	1 15	11,500
Tobacco .... pounds...	165,000	680	242	15	24,750
Hay .... tons..	....	....	....	....	....
Total	....	....	217,742	....	3,186,100
ALABAMA.					
Indian corn .... bushels..	35,334,000	17.5	2,019,085	93	32,860,620
Wheat .... do....	1,041,000	8.4	123,928	1 28	1,332,480
Rye .... do....	60.000	9.7	6,185	1 06	63,600
Oats .... do....	700,000	15.6	44,871	79	553,000
Barley .... do....	....	....	....	....	....
Buckwheat .... do....	....	....	....	....	....
Potatoes .... do....	450,000	70	6,428	1 37	616,500
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons....	62,000	1.33	46,616	20 00	1,240,000
Total	....	....	2,247,113	....	36,666,200
MISSISSIPPI.					
Indian corn .... bushels..	30,300,000	16.5	1,836,363	98	29,694,000
Wheat .... do....	221,000	9.7	22,783	1 52	335,920
Rye .... do....	21,000	10	2,100	1 62	34,020
Oats .... do....	300,000	14.5	20,689	90	270,000
Barley .... do....	....	....	....	....	....
Buckwheat .... do....	....	....	....	....	....
Potatoes .... do....	392,000	73	5,369	1 16	454,720
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons....	39,000	1.37	28,467	21 25	828,750
Total	....	....	1,915,771	....	31,617,410

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1870.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
LOUISIANA.					
Indian corn .....bushels..	18,000,000	22.5	800,000	$1 10	$19,800,000
Wheat .....do....	41,000	9.7	4,226	1 52	62,320
Rye .....do....	21,000	10	2,100	1 62	34,020
Oats .....do....	87,000	25	3,480	75	65,250
Barley .....do....					
Buckwheat .....do....					
Potatoes .....do....	297,000	105	2,828	1 16	344,520
Tobacco .....pounds..					
Hay .....tons..	35,800	1.50	23,866	28 50	1,020,300
Total.....			836,500		21,326,410
TEXAS.					
Indian corn .....bushels..	23,690,000	26.5	893,962	1 06	25,111,400
Wheat .....do....	1,225,000	11.7	104,700	1 73	2,119,250
Rye .....do....	95,000	19.1	4,973	1 11	105,450
Oats .....do....	1,500,000	21.6	69,444	1 00	1,500,000
Barley .....do....	54,000	30	1,800	1 33	71,820
Buckwheat .....do....					
Potatoes .....do....	400,000	128	3,125	1 33	532,000
Tobacco .....pounds..					
Hay .....tons..	25,000	1.60	15,625	15 36	384,000
Total.....			1,093,629		29,823,920
ARKANSAS.					
Indian corn .....bushels..	25,000,000	31.8	786,163	80	20,000,000
Wheat .....do....	1,251,000	10.8	115,833	1 30	1,626,300
Rye .....do....	41,600	18.2	2,285	1 00	41,600
Oats .....do....	671,000	23.6	28,432	62	416,020
Barley .....do....					
Buckwheat .....do....					
Potatoes .....do....	450,000	109	4,128	1 07	481,500
Tobacco .....pounds..	2,225,000	666	3,340	.15.3	340,425
Hay .....tons..	10,200	1.50	6,800	15 00	153,000
Total.....			946,981		23,058,845
TENNESSEE.					
Indian corn .....bushels..	51,000,000	25.8	1,976,744	47	23,970,000
Wheat .....do....	7,357,000	8.8	836,022	97	7,136,290
Rye .....do....	232,000	11.3	20,530	81	187,920
Oats .....do....	3,920,000	19.3	203,108	46	1,803,200
Barley .....do....	30,800	22.5	1,368	75	23,100
Buckwheat .....do....	9,500	20	475	75	7,125
Potatoes .....do....	1,220,000	88	13,863	52	634,400
Tobacco .....pounds..	35,000,000	845	41,420	08.3	2,905,000
Hay .....tons..	155,000	1.43	108,391	16 64	2,579,200
Total.....			3,201,921		39,246,235
WEST VIRGINIA.					
Indian corn .....bushels..	9,837,000	30.4	323,585	64	6,295,680
Wheat .....do....	2,533,000	11.4	222,105	1 22	3,090,260
Rye .....do....	280,000	14.1	19,858	83	232,400
Oats .....do....	2,655,000	27.2	97,610	40	1,062,000
Barley .....do....	56,000	20	2,800	85	47,600
Buckwheat .....do....	77,000	19.9	3,869	80	61,600
Potatoes .....do....	1,021,000	85	12,011	58	592,180
Tobacco .....pounds..	2,292,000	760	3,015	11.3	258,996
Hay .....tons..	242,000	1.26	192,063	10 00	2,420,000
Total.....			876,916		14,060,716

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1870.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
KENTUCKY.					
Indian corn .... bushels..	63, 345, 000	32. 1	1, 973, 364	$0 48	$30, 405, 600
Wheat .... do....	5, 610, 000	10	561, 000	1 00	5, 610, 000
Rye .... do....	790, 000	12. 1	65, 289	71	560, 900
Oats .... do....	6, 148, 000	23. 2	265, 000	40	2, 459, 200
Barley .... do....	304, 000	19	16, 000	1 05	319, 200
Buckwheat .... do....	18, 000	16. 7	1, 077	75	13, 500
Potatoes .... do....	1, 800, 000	78	23, 076	63	1, 134, 000
Tobacco .... pounds..	45, 000, 000	696	64, 655	08. 2	3, 690, 000
Hay .... tons..	160, 000	1. 36	117, 647	13 25	2, 120, 000
Total	....	....	3, 087, 108	....	46, 312, 400
MISSOURI.					
Indian corn .... bushels..	94, 990, 000	31. 4	3, 025, 159	44	41, 795, 600
Wheat .... do....	6, 750, 000	13	519, 230	91	6, 142, 500
Rye .... do...	299, 000	15. 6	19, 166	68	203, 320
Oats .... do....	5, 525, 000	25	221, 000	37	2, 044, 250
Barley .... do....	285, 000	26. 4	10, 795	84	239, 400
Buckwheat .... do....	84, 000	23. 6	3, 559	67	56, 280
Potatoes .... do....	2, 200, 000	103	21, 359	56	1, 232, 000
Tobacco .... pounds..	19, 610, 000	750	26, 146	09. 3	1, 823, 730
Hay .... tons..	532, 000	1. 29	412, 403	12 82	6, 820, 240
Total	....	....	4, 258, 817	....	60, 357, 320
ILLINOIS.					
Indian corn .... bushels..	201, 378, 000	35. 2	5, 720, 965	35	70, 482, 300
Wheat .... do....	27, 115, 000	12	2, 259, 583	94	25, 488, 100
Rye .... do....	2, 235, 000	16. 4	136, 280	60	1, 341, 000
Oats .... do....	38, 502, 000	26	1, 480, 846	32	12, 320, 640
Barley .... do....	2, 232, 000	20	111, 600	62	1, 383, 840
Buckwheat .... do....	206, 000	18. 8	10, 957	68	140, 080
Potatoes .... do....	8, 427, 000	81	104, 037	64	5, 393, 280
Tobacco .... pounds..	5, 564, 000	840	6, 623	12. 8	712, 192
Hay .... tons..	1, 895, 000	1. 18	1, 605, 932	10 74	20, 352, 300
Total	....	....	11, 436, 823	....	137, 613, 732
INDIANA.					
Indian corn .... bushels..	113, 150, 000	39. 5	2, 864, 556	38	42, 997, 000
Wheat .... do....	20, 200, 000	11	1, 836, 363	1 00	20, 200, 000
Rye .... do....	517, 000	13. 7	37, 737	70	361, 900
Oats .... do....	11, 668, 000	28. 1	415, 231	35	4, 083, 800
Barley .... do....	800, 000	24. 1	33, 195	83	664, 000
Buckwheat .... do....	309, 000	19. 2	16, 093	71	219, 390
Potatoes .... do....	2, 565, 000	45	57, 000	83	2, 128, 950
Tobacco .... pounds..	6, 930, 000	850	8, 152	05. 3	367, 290
Hay .... tons..	972, 000	1. 27	765, 354	11 46	11, 139, 120
Total	....	....	6, 033, 681	....	82, 161, 450
OHIO.					
Indian corn .... bushels..	87, 751, 000	39	2, 250, 025	48	42, 120, 480
Wheat .... do....	19, 150, 000	13. 8	1, 387, 681	1 09	20, 873, 500
Rye .... do....	450, 000	13. 8	32, 608	76	342, 000
Oats .... do....	24, 500, 000	31. 1	787, 781	38	9, 310, 000
Barley .... do....	1, 578, 000	23. 5	67, 148	86	1, 357, 080
Buckwheat .... do....	270, 000	16. 3	16, 564	85	229, 500
Potatoes .... do....	8, 282, 000	72	115, 027	81	6, 708, 420
Tobacco .... pounds..	21, 100, 000	916	23, 034	12. 3	2, 595, 300
Hay .... tons..	1, 923, 000	1. 31	1, 467, 938	11 02	21, 191, 460
Total	....	....	6, 147, 806	....	104, 727, 740

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1870.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
MICHIGAN.					
Indian corn..........bushels..	19, 035, 000	37	514, 459	$0 55	$10, 469, 250
Wheat..........do....	15, 288, 000	14	1, 092, 000	1 08	16, 511, 040
Rye..........do....	604, 000	18. 2	33, 186	75	453, 000
Oats..........do....	9, 831, 000	35. 3	278, 498	39	3, 834, 090
Barley..........do....	630, 000	25	25, 200	80	504, 000
Buckwheat..........do....	901, 000	17. 3	52, 080	62	558, 620
Potatoes..........do....	7, 000, 000	95	73, 684	58	4, 060, 000
Tobacco..........pounds..	3, 500, 000	950	3, 684	20	700, 000
Hay..........tons..	1, 472, 000	1. 36	1, 082, 352	11 17	16, 442, 240
Total..........	....	....	3, 155, 143	....	53, 532, 210
WISCONSIN.					
Indian corn..........bushels..	19, 995, 000	38	526, 184	52	10, 397, 400
Wheat..........do....	20, 485, 000	13. 4	1, 528, 731	90	18, 436, 500
Rye..........do....	1, 219, 000	13. 6	89, 632	62	755, 780
Oats..........do....	14, 327, 000	27. 9	513, 512	39	5, 587, 530
Barley..........do....	1, 431, 000	26. 5	54, 000	67	958, 770
Buckwheat..........do....	498, 000	20. 1	24, 776	54	268, 920
Potatoes..........do....	4, 585, 000	57	80, 438	74	3, 392, 900
Tobacco..........pounds..	1, 037, 000	900	1, 152	18	186, 660
Hay..........tons..	1, 223, 000	1. 34	912, 686	10 43	12, 755, 890
Total..........	....	....	3, 731, 111	....	52, 740, 350
MINNESOTA.					
Indian corn..........bushels..	5, 823, 000	33	176, 454	51	2, 969, 730
Wheat..........do....	16, 022, 000	15. 2	1, 054, 078	83	13, 298, 260
Rye..........do....	74, 000	17. 7	4, 180	56	41, 440
Oats..........do....	8, 959, 000	32. 9	272, 310	34	3, 046, 060
Barley..........do....	980, 000	24. 5	40, 000	54	529, 200
Buckwheat..........do....	53, 000	18. 6	2, 849	60	31, 800
Potatoes..........do....	1, 274, 000	53	24, 037	95	1, 210, 300
Tobacco..........pounds..	....	....	....	....	....
Hay..........tons..	724, 000	1. 47	492, 517	6 77	4, 901, 480
Total..........	....	....	2, 066, 425	....	26, 028, 270
IOWA.					
Indian corn..........bushels..	93, 415, 000	32	2, 919, 218	34	31, 761, 100
Wheat..........do....	20, 445, 000	12. 5	1, 635, 600	78	15, 947, 100
Rye..........do....	518, 000	17. 6	29, 431	58	300, 440
Oats..........do....	16, 340, 000	29. 7	550, 168	30	4, 902, 000
Barley..........do....	1, 227, 000	26	47, 192	63	773, 010
Buckwheat..........do....	200, 000	21. 6	9, 259	69	138, 000
Potatoes..........do....	4, 680, 000	95	49, 263	52	2, 433, 600
Tobacco..........pounds..	....	....	....	....	....
Hay..........tons..	1, 600, 000	1. 34	1, 194, 029	7 70	12, 320, 000
Total..........	....	....	6, 434, 160	....	68, 575, 250
KANSAS.					
Indian corn..........bushels..	16, 685, 000	28	595, 892	58	9, 677, 300
Wheat..........do....	2, 343, 000	15	156, 200	86	2, 014, 980
Rye..........do....	77, 500	20. 8	3, 725	69	53, 475
Oats..........do....	3, 688, 000	31. 5	117, 079	40	1, 475, 200
Barley..........do....	92, 500	24	3, 854	75	69, 375
Buckwheat..........do....	31, 000	20. 6	1, 504	77	23, 870
Potatoes..........do....	3, 139, 000	106	29, 613	56	1, 757, 840
Tobacco..........pounds..	....	....	....	....	....
Hay..........tons..	529, 000	1. 17	452, 136	7 18	3, 798, 220
Total..........	....	....	1, 360, 003	....	18, 870, 260

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1870.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
NEBRASKA.					
Indian corn........bushels..	5,163,000	29.9	172,675	$0 36	$1,858,680
Wheat........do....	1,848,000	14.4	128,333	64	1,182,720
Rye........do....	12,900	23.7	544	54	6,966
Oats........do....	1,226,000	33.7	36,379	30	367,800
Barley........do....	233,700	29	8,058	65	151,905
Buckwheat........do....	2,800	26.2	106	1 26	3,528
Potatoes........do....	769,000	94	8,180	56	430,640
Tobacco........pounds..	....	....	....	....	....
Hay........tons..	145,000	1.40	103,571	5 60	812,000
Total........	....	....	457,846	....	4,814,239
CALIFORNIA.					
Indian corn........bushels..	1,099,000	35.6	30,870	1 20	1,318,800
Wheat........do....	14,175,000	19	746,052	1 10	15,592,500
Rye........do....	24,900	38	655	1 19	29,631
Oats........do....	1,581,000	35.5	44,535	59	932,790
Barley........do....	7,378,000	26.9	274,275	98	7,230,440
Buckwheat........do....	22,500	32.5	692	1 07	24,075
Potatoes........do....	1,823,000	148	12,317	1 35	2,461,050
Tobacco........pounds..	....	....	....	....	....
Hay........tons..	617,000	1.48	416,891	16 70	10,303,900
Total........	....	....	1,526,287	....	37,893,186
OREGON.					
Indian corn........bushels..	88,000	29.7	2,962	1 00	88,000
Wheat........do....	2,270,000	19.5	116,410	95	2,156,500
Rye........do....	3,800	25	152	87	3,306
Oats........do....	1,867,000	36	51,861	46	858,820
Barley........do....	202,000	32.3	6,253	68	137,360
Buckwheat........do....	1,400	30.7	45	1 41	1,974
Potatoes........do....	414,000	87	4,758	77	318,780
Tobacco........pounds..	....	....	....	....	....
Hay........tons..	86,000	1.45	59,310	12 05	1,036,300
Total........	....	....	241,751	....	4,601,040
NEVADA.					
Indian corn........bushels..	11,000	35	314	1 25	13,750
Wheat........do....	251,000	23.5	10,680	1 50	376,500
Rye........do....	300	24	12	1 25	375
Oats........do....	59,000	32.5	1,815	83	48,970
Barley........do....	324,000	27.5	11,781	1 12	362,880
Buckwheat........do....	900	27.5	32	1 10	990
Potatoes........do....	155,000	87	1,781	1 84	285,200
Tobacco........pounds..	....	....	....	....	....
Hay........tons..	40,000	1.35	29,629	22 50	900,000
Total........	....	....	56,044	....	1,988,665
THE TERRITORIES.					
Indian corn........bushels..	1,230,000	35.9	34,261	99	1,217,700
Wheat........do....	1,675,000	25.7	65,175	1 21	2,026,750
Rye........do....	13,000	23	565	1 24	16,120
Oats........do....	1,031,000	33	31,242	78	804,180
Barley........do....	328,000	30.2	10,860	98	321,440
Buckwheat........do....	1,900	28.5	66	1 00	1,900
Potatoes........do....	973,000	145	6,710	99	963,270
Tobacco........pounds..	....	....	....	....	....
Hay........tons..	128,000	1.55	82,580	15 96	2,042,880
Total........	....	....	231,459	....	7,394,2[illegible]

Summary for each State, showing the product, the number of acres, and the value of each crop for 1870.

STATES.	INDIAN CORN.			WHEAT.			RYE.		
	Bushels.	Acres.	Value of crop.	Bushels.	Acres.	Value of crop.	Bushels.	Acres.	Value of crop.
Maine	1,198,000	36,303	$1,365,720	264,000	17,637	$169,920	32,000	1,818	$44,160
New Hampshire	1,213,000	33,232	1,322,170	174,000	11,756	276,660	43,000	2,687	53,320
Vermont	1,920,000	48,484	2,112,000	409,000	24,345	666,670	67,000	4,240	77,050
Massachusetts	1,327,000	40,212	1,300,460	35,000	1,988	61,250	232,000	15,064	255,200
Rhode Island	280,000	10,769	296,800	700	39	1,225	20,600	1,144	26,162
Connecticut	1,413,000	53,522	1,610,820	38,000	2,134	57,760	289,000	20,069	335,240
New York	19,426,000	571,352	16,900,620	9,133,000	661,811	12,877,530	2,230,000	171,538	2,163,100
New Jersey	10,057,000	304,757	8,146,170	1,680,000	131,250	2,402,400	470,000	35,071	455,900
Pennsylvania	38,866,000	1,085,642	29,149,500	17,115,000	1,426,250	21,736,050	3,148,000	262,333	2,801,720
Delaware	3,311,000	132,440	2,152,150	626,000	62,600	782,500	10,000	892	8,300
Maryland	11,818,000	525,244	8,390,780	4,792,000	494,020	6,133,760	264,000	25,142	265,920
Virginia	19,360,000	968,000	12,584,000	6,705,000	698,437	8,314,200	519,000	54,062	378,870
North Carolina	22,500,000	1,541,095	17,550,000	4,218,000	490,465	5,103,780	490,000	48,192	388,000
South Carolina	12,000,000	1,318,311	12,720,000	1,012,000	111,571	1,912,680	60,000	10,341	102,000
Georgia	31,000,000	2,296,296	27,900,000	2,337,000	298,375	3,508,890	100,000	12,345	149,000
Florida	2,247,000	208,055	3,033,450	....	....	....	....	....	....
Alabama	35,331,000	2,019,085	32,860,620	1,041,000	123,928	1,332,480	60,000	6,185	63,600
Mississippi	30,300,000	1,836,363	29,694,000	221,000	22,763	335,920	21,000	2,160	34,020
Louisiana	18,000,000	800,000	19,800,000	41,000	4,226	62,320	21,000	2,100	31,020
Texas	23,690,000	893,962	25,111,400	1,225,000	101,700	2,119,250	95,000	4,973	105,450
Arkansas	25,000,000	786,163	20,000,000	1,251,000	115,833	1,626,300	41,600	2,285	41,600
Tennessee	51,000,000	1,976,744	23,970,000	7,357,000	836,022	7,136,290	232,000	20,550	187,920
West Virginia	9,837,000	323,585	6,295,680	2,533,000	222,105	3,090,260	280,000	19,858	232,400
Kentucky	63,315,000	1,973,364	30,405,600	5,610,000	561,000	5,616,000	790,000	65,289	560,900
Missouri	91,990,000	3,025,159	41,795,600	6,750,000	519,230	6,142,500	299,000	19,166	203,320
Illinois	201,378,000	5,720,965	70,482,300	27,115,000	2,259,583	25,488,160	2,235,000	136,280	1,341,000
Indiana	113,150,000	2,864,556	42,997,000	20,200,000	1,836,363	20,200,000	517,000	57,737	361,900
Ohio	87,751,000	2,250,025	42,120,480	19,150,000	1,387,681	20,873,500	450,000	52,608	342,000
Michigan	19,035,000	511,459	10,469,250	15,288,000	1,092,000	16,511,040	601,000	33,186	453,000
Wisconsin	19,995,000	526,184	10,397,400	20,485,000	1,528,731	18,436,500	1,219,000	83,632	755,780
Minnesota	5,823,000	176,451	2,969,730	16,022,000	1,054,078	13,298,260	71,000	4,180	41,140
Iowa	93,415,000	2,919,218	31,761,100	20,445,000	1,635,630	15,947,100	515,000	29,431	350,440
Kansas	16,685,000	595,892	9,677,300	2,343,000	156,209	2,014,980	77,500	3,725	58,475
Nebraska	5,163,000	172,675	1,858,680	1,818,000	128,333	1,182,720	12,900	741	6,966
California	1,099,000	30,870	1,318,800	14,175,000	746,052	15,592,500	24,900	675	23,631
Oregon	88,000	2,962	88,000	2,270,000	116,110	2,156,500	3,800	162	3,306
Nevada	11,000	314	13,750	251,000	10,680	376,500	300	12	375
The Territories	1,230,000	54,261	1,217,700	1,675,000	65,175	2,026,750	13,000	565	16,120
Total	1,094,255,000	38,646,977	601,839,030	235,884,700	18,992,591	245,865,045	15,473,600	1,176,137	12,612,605

Summary for each State, showing the product, the number of acres, and the value of each crop for 1870—Continued.

STATES.	OATS.			BARLEY.			BUCKWHEAT.		
	Bushels.	Acres.	Value of crop.	Bushels.	Acres.	Value of crop.	Bushels.	Acres.	Value of crop.
Maine	2,163,000	78,941	$1,405,950	586,000	30,051	$580,140	443,000	18,458	$332,250
New Hampshire	1,066,000	35,892	703,560	96,000	4,465	102,720	87,000	5,800	72,210
Vermont	3,170,000	94,065	1,870,300	107,000	4,592	108,070	336,000	19,200	252,000
Massachusetts	733,000	27,765	535,090	126,000	6,086	136,080	38,000	2,714	38,760
Rhode Island	152,000	4,648	92,720	30,000	1,250	28,800	1,400	100	1,428
Connecticut	913,000	28,179	629,970	24,000	905	24,480	96,000	6,857	100,800
New York	29,646,000	915,000	17,194,680	6,616,000	312,075	5,623,600	3,435,000	191,899	2,782,350
New Jersey	4,049,000	130,612	2,186,460	7,000	250	7,700	311,000	12,798	311,000
Pennsylvania	34,289,000	1,051,809	16,458,720	497,000	20,794	452,270	2,278,000	126,555	1,936,300
Delaware	498,000	24,900	249,000	1,700	85	1,564	1,300	65	1,399
Maryland	3,286,000	136,916	1,544,420	10,700	486	9,630	67,000	4,962	74,370
Virginia	7,175,000	367,948	3,013,500	7,000	350	5,600	44,000	2,750	30,800
North Carolina	2,750,000	169,753	1,567,500	2,000	90	1,220	17,800	831	10,324
South Carolina	926,000	95,463	777,840	7,000	466	6,650	...	...	...
Georgia	1,260,000	86,301	1,045,800	12,000	800	11,640	...	...	...
Florida	116,400	9,312	116,400	...	...	...	...	...	...
Alabama	700,000	44,871	553,000	...	...	...	...	...	...
Mississippi	300,000	20,689	270,000	...	...	...	...	...	...
Louisiana	87,000	3,480	65,250	...	...	...	...	...	...
Texas	1,500,000	69,444	1,500,000	54,000	1,800	71,820	...	...	...
Arkansas	671,000	28,432	416,020	...	...	...	...	...	...
Tennessee	3,920,000	203,108	1,803,200	30,800	1,368	23,100	9,500	475	7,125
West Virginia	2,655,000	97,610	1,062,000	56,000	2,800	47,600	77,000	3,869	61,600
Kentucky	6,148,000	265,000	2,459,200	304,000	16,000	319,200	18,000	1,077	13,500
Missouri	5,525,000	221,000	2,044,250	285,000	10,795	239,400	84,000	3,559	56,280
Illinois	38,552,000	1,480,846	12,320,640	2,232,000	111,600	1,383,840	206,000	10,957	140,080
Indiana	11,668,000	415,231	4,083,800	800,000	33,195	664,000	309,000	16,093	219,390
Ohio	24,500,000	787,781	9,310,000	1,578,000	67,148	1,357,080	270,000	16,564	229,500
Michigan	9,831,000	278,498	3,834,090	630,000	25,200	504,000	901,000	52,080	558,620
Wisconsin	14,327,000	513,512	5,587,530	1,431,000	54,000	958,770	498,000	24,776	268,920
Minnesota	8,959,000	272,310	3,046,060	980,000	40,000	529,200	53,000	2,849	31,800
Iowa	16,340,000	550,168	4,902,000	1,227,000	47,192	773,010	200,000	9,259	138,000
Kansas	3,688,000	117,079	1,475,209	92,500	3,854	69,375	31,000	1,504	23,870
Nebraska	1,226,000	36,379	367,800	233,700	8,058	151,905	2,800	106	3,528
California	1,581,000	41,535	932,790	7,378,000	274,275	7,230,440	22,500	692	24,075
Oregon	1,867,000	51,861	858,820	202,000	6,253	137,360	1,400	45	1,974
Nevada	59,000	1,815	48,970	324,000	11,781	362,880	900	32	990
The Territories	1,031,000	31,242	804,180	328,000	10,860	321,440	1,900	66	1,900
Total	247,277,400	8,792,395	107,136,710	26,295,400	1,108,924	22,244,584	9,841,500	536,992	7,725,044

Summary for each State, showing the product, the number of acres, and the value of each crop for 1870—Continued.

STATES.	POTATOES.			TOBACCO.			HAY.		
	Bushels.	Acres.	Value of crop.	Pounds.	Acres.	Value of crop.	Tons.	Acres.	Value of crop.
Maine	6, 527, 000	52, 216	$4, 307, 820				821, 000	1, 026, 250	$16, 165, 490
New Hampshire	2, 980, 000	33, 863	2, 354, 200	150, 000	150	$33, 000	520, 000	541, 666	10, 322, 000
Vermont	4, 899, 000	34, 992	2, 498, 490	70, 000	66	15, 400	979, 000	1, 019, 791	14, 195, 500
Massachusetts	2, 208, 000	25, 090	2, 119, 680	6, 289, 000	4, 658	1, 509, 360	507, 000	473, 831	13, 252, 980
Rhode Island	488, 000	6, 177	478, 240				89, 000	81, 651	2, 136, 000
Connecticut	1, 729, 000	23, 684	1, 711, 710	7, 495, 000	5, 996	1, 693, 870	433, 000	333, 076	11, 084, 600
New York	25, 121, 000	256, 336	16, 328, 650	2, 584, 000	2, 319	516, 800	4, 491, 000	3, 651, 219	77, 290, 110
New Jersey	3, 858, 000	51, 440	3, 626, 520	40, 000	31	9, 200	553, 000	395, 000	10, 750, 320
Pennsylvania	11, 084, 000	127, 402	8, 645, 520	3, 294, 000	2, 745	691, 740	2, 734, 000	2, 103, 076	35, 678, 700
Delaware	217, 000	2, 893	217, 000				37, 000	37, 000	740, 000
Maryland	897, 000	13, 388	807, 300	14, 522, 000	22, 797	1, 248, 892	232, 000	190, 163	3, 788, 560
Virginia	1, 236, 000	22, 472	877, 560	43, 761, 000	59, 216	3, 194, 553	216, 000	156, 521	3, 179, 520
North Carolina	742, 000	9, 160	519, 400	30, 000, 000	51, 194	4, 230, 000	169, 000	120, 714	1, 938, 430
South Carolina	113, 000	2, 354	129, 950				74, 000	74, 000	1, 602, 840
Georgia	350, 000	4, 487	469, 000				55, 000	41, 044	1, 283, 150
Florida	10, 000	133	11, 500	165, 000	212	21, 750			
Alabama	450, 000	6, 428	616, 500				62, 000	46, 616	1, 240, 000
Mississippi	392, 000	5, 369	454, 720				39, 000	28, 467	828, 750
Louisiana	297, 000	2, 828	344, 520				35, 800	23, 866	1, 020, 300
Texas	400, 000	3, 125	532, 000				25, 000	15, 625	384, 000
Arkansas	450, 000	4, 128	481, 500	2, 225, 000	3, 340	340, 425	10, 200	6, 800	153, 000
Tennessee	1, 220, 000	13, 863	634, 400	35, 000, 000	41, 420	2, 905, 000	155, 000	108, 391	2, 579, 200
West Virginia	1, 021, 000	12, 011	592, 180	2, 292, 000	3, 015	258, 996	242, 000	192, 063	2, 420, 000
Kentucky	1, 800, 000	23, 076	1, 134, 000	45, 000, 000	64, 655	3, 690, 000	160, 000	117, 647	2, 120, 000
Missouri	2, 200, 000	21, 359	1, 232, 000	19, 610, 000	26, 146	1, 823, 730	532, 000	412, 403	6, 820, 240
Illinois	8, 427, 000	104, 037	5, 393, 280	5, 564, 000	6, 623	712, 192	1, 895, 000	1, 605, 932	20, 352, 300
Indiana	2, 565, 000	57, 000	2, 128, 950	6, 930, 000	8, 152	367, 290	972, 000	765, 354	11, 139, 120
Ohio	8, 282, 000	115, 027	6, 708, 420	21, 100, 000	23, 034	2, 595, 300	1, 923, 000	1, 467, 938	21, 191, 460
Michigan	7, 000, 000	73, 684	4, 060, 000	3, 500, 000	3, 684	700, 000	1, 472, 000	1, 082, 352	16, 442, 240
Wisconsin	4, 585, 000	80, 438	3, 392, 900	1, 037, 000	1, 152	186, 660	1, 223, 000	912, 686	12, 755, 890
Minnesota	1, 274, 000	24, 037	1, 210, 300				724, 000	492, 517	4, 901, 480
Iowa	4, 680, 000	49, 263	2, 433, 600				1, 600, 000	1, 194, 029	12, 320, 000
Kansas	3, 139, 000	29, 613	1, 757, 840				529, 000	452, 136	3, 798, 220
Nebraska	769, 000	8, 180	430, 640				145, 000	103, 571	812, 000
California	1, 823, 000	12, 317	2, 461, 050				617, 000	416, 891	10, 303, 900
Oregon	414, 000	4, 758	318, 780				86, 000	59, 310	1, 036, 300
Nevada	155, 000	1, 781	285, 200				40, 000	29, 629	900, 000
The Territories	973, 000	6, 710	963, 270				128, 000	82, 580	2, 042, 880
Total	114, 775, 000	1, 325, 119	82, 668, 590	250, 628, 000	330, 668	26, 747, 158	24, 525, 000	19, 861, 605	338, 969, 680

A general summary showing the estimated quantities, number of acres, and aggregate value of the principal crops of the farm in 1870.

Products.	Number of bushels.	Number of acres.	Value.
Indian corn	1,094,255,000	38,646,977	601,839,030
Wheat	235,884,700	18,992,591	245,865,045
Rye	15,473,600	1,176,137	12,612,605
Oats	247,277,400	8,792,395	107,136,710
Barley	26,295,400	1,108,924	22,244,584
Buckwheat	9,841,500	536,992	7,725,044
Potatoes	114,775,000	1,325,119	82,668,590
Total	1,743,802,600	70,579,135	1,080,091,608
Tobacco ... pounds	250,628,000	330,668	26,747,158
Hay ... tons	24,525,000	19,861,805	338,969,680
Cotton ... bales	4,400,000	8,680,000	286,000,000
Total	....	99,451,608	1,731,808,446

Table showing the average yield and cash value, and price per bushel, ton, or pound, of farm products for the year 1870.

Products.	Average yield per acre.	Average price per bushel.	Average value per acre.	Products.	Average yield per acre.	Average price per bush., ton, or pound.	Average value per acre.
Indian corn ..bushels	28.3+	$0 54.9+	$15 57	Buckwheat ..bushels	18.3 +	$0 78.4+	$14 38
Wheat ...do	12.4+	1 04.2+	12 94	Potatoes ...do	86.6 +	72 +	62 38
Rye ...do	13.1+	81.5+	10 72	Tobacco ...pounds	757 +	10.6+	80 88
Oats ...do	28.1+	43.3+	12 18	Hay ...tons	1.23+	13 82 +	17 06
Barley ...do	23.7+	84.5+	20 05	Cotton ...pounds	236	14 —	32 94

Table showing the average yield of farm products per acre for the year 1870.

States.	Corn.	Wheat.	Rye.	Oats.	Barley.	Buck-wheat.	Potatoes.	Tobacco.	Hay.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Pounds.*	*Tons.*
Maine	33.0	14.8	17.6	27.4	19.5	24.0	125	....	.80
New Hampshire	36.5	14.8	16.0	29.7	21.5	15.0	88	1,000	.96
Vermont	39.6	16.8	15.8	33.7	23.3	17.5	140	1,050	.96
Massachusetts	33.0	17.6	15.4	26.4	20.7	14.0	88	1,350	1.07
Rhode Island	26.0	17.6	18.0	32.7	24.0	14.0	79	....	1.09
Connecticut	26.4	17.8	14.4	32.4	26.5	14.0	73	1,250	1.30
New York	34.0	13.8	13.0	32.4	21.2	17.9	98	1,100	1.23
New Jersey	33.0	12.8	13.4	31.0	28.0	24.3	75	1,150	1.40
Pennsylvania	35.8	12.0	12.0	32.6	23.9	18.0	87	1,200	1.30
Delaware	25.0	10.0	11.2	20.0	20.0	20.0	75	....	1.00
Maryland	22.5	9.7	10.5	24.0	22.0	13.5	67	637	1.22
Virginia	20.0	9.6	9.6	19.5	20.0	16.0	55	739	1.38
North Carolina	14.6	8.6	8.3	16.2	22.0	21.4	81	586	1.40
South Carolina	8.9	7.0	5.8	9.7	15.0	....	48	....	1.00
Georgia	13.5	8.0	8.1	14.6	15.0	....	78	....	1.34
Florida	10.8	....	....	12.5	....	....	75	680	....
Alabama	17.5	8.4	9.7	15.6	....	....	70	....	1.33
Mississippi	16.5	9.7	10.0	14.5	....	....	73	....	1.37
Louisiana	22.5	9.7	10.0	25.0	....	....	105	....	1.50
Texas	26.5	11.7	19.1	21.6	30.0	....	128	....	1.60
Arkansas	31.8	10.8	18.2	23.6	....	....	109	666	1.50
Tennessee	25.8	8.8	11.3	19.3	22.5	20.0	88	845	1.43
West Virginia	30.4	11.4	14.1	27.2	20.0	19.9	85	760	1.26
Kentucky	32.1	10.0	12.1	23.2	19.0	16.7	78	696	1.36
Missouri	31.4	13.0	15.6	25.0	26.4	23.6	103	750	1.29
Illinois	35.2	12.0	16.4	26.0	20.0	18.8	81	840	1.18
Indiana	39.5	11.0	13.7	28.1	24.1	19.2	45	850	1.27
Ohio	39.0	13.8	13.8	31.1	23.5	16.3	72	916	1.31
Michigan	37.0	14.0	18.2	35.3	25.0	17.3	95	950	1.36
Wisconsin	38.0	13.4	13.6	27.9	26.5	20.1	57	900	1.34
Minnesota	33.0	15.2	17.7	32.9	24.5	18.6	53	....	1.47
Iowa	32.0	12.5	17.6	29.7	26.0	21.6	95	....	1.34
Kansas	28.0	15.0	20.8	31.5	24.0	20.6	106	....	1.17
Nebraska	29.9	14.4	23.7	33.7	29.0	26.2	94	....	1.40
California	35.6	19.0	38.0	35.5	26.9	32.5	148	....	1.48
Oregon	29.7	19.5	25.0	36.0	32.3	30.7	87	....	1.45
Nevada	35.0	23.5	24.0	32.5	27.5	27.5	87	....	1.35
The Territories	35.9	25.7	23.0	33.0	30.2	28.5	145	....	1.55

Table showing the average cash value of farm products per acre for the year 1870.

States.	Corn.	Wheat.	Rye.	Oats.	Barley.	Buckwheat.	Potatoes.	Tobacco.	Hay.
Maine	$37 62	$26 34	$24 28	$17 81	$19 30	$18 00	$82 50	....	$15 75
New Hampshire	39 78	23 53	19 84	19 60	23 00	12 45	69 52	$220 00	19 05
Vermont	43 56	27 38	18 17	19 88	23 53	13 12	71 40	231 00	13 92
Massachusetts	32 34	30 80	16 94	19 27	22 35	14 28	84 48	324 00	27 96
Rhode Island	27 56	30 80	22 86	19 94	23 04	14 28	77 42	....	26 16
Connecticut	30 09	27 05	16 70	22 35	27 03	14 70	72 27	282 50	33 28
New York	29 58	19 45	12 61	18 79	18 02	14 49	63 70	220 00	21 16
New Jersey	26 73	18 30	12 99	16 74	30 80	24 30	70 50	264 50	27 21
Pennsylvania	26 85	15 24	10 62	15 64	21 74	15 30	67 86	252 00	16 96
Delaware	16 25	12 50	9 20	10 00	18 40	20 00	75 00	....	20 00
Maryland	15 97	12 41	8 19	11 28	19 80	14 98	60 30	51 78	19 92
Virginia	13 00	11 90	7 00	8 19	16 00	11 20	30 05	53 94	20 31
North Carolina	11 38	10 40	8 05	9 23	13 42	12 41	56 70	82 62	16 05
South Carolina	9 43	13 23	9 86	8 14	14 25	....	55 20	....	21 66
Georgia	12 15	11 76	12 06	12 11	14 55	....	104 52	....	31 26
Florida	14 58	....	....	12 50	....	....	86 25	102 00	....
Alabama	16 27	10 75	10 28	12 32	....	....	95 90	....	26 60
Mississippi	16 17	14 74	16 20	13 05	....	....	84 68	....	29 11
Louisiana	24 75	14 74	16 20	18 75	....	....	121 80	....	42 75
Texas	28 09	20 24	21 20	21 60	39 90	....	170 24	....	24 57
Arkansas	25 44	14 04	18 20	14 63	....	....	116 63	101 89	22 50
Tennessee	12 12	8 53	9 15	8 87	16 87	15 00	45 76	70 13	23 79
West Virginia	19 45	13 90	11 70	10 88	17 00	15 92	49 30	85 88	12 60
Kentucky	15 40	10 00	8 59	9 28	19.95	12 52	49 14	57 07	18 [illegible]
Missouri	13 81	11 83	10 60	9 25	22 17	15 81	57 68	69 75	16 53
Illinois	12 32	11 28	9 84	8 52	12 40	12 7[illegible]	51 81	107 52	12 67
Indiana	15 01	11 00	9 59	9 83	20 00	13 63	37 35	45 05	14 55
Ohio	18 72	15 04	10 48	11 81	20 21	13 85	58 32	112 66	14 43
Michigan	20 35	15 12	13 65	13 76	20 00	10 72	55 10	190 00	15 19
Wisconsin	19 76	12 06	8 43	10 88	17 75	10 85	42 18	162 00	13 97
Minnesota	16 83	12 61	9 91	11 18	13 23	11 16	50 35	....	9 95
Iowa	10 88	9 75	10 20	8 91	16 38	14 90	49 40	....	10 31
Kansas	16 24	12 90	14 35	12 60	18 00	15 86	59 36	....	8 40
Nebraska	10 76	9 21	12 79	10 11	18 85	33 01	52 64	....	7 84
California	42 72	20 90	45 22	20 94	26 36	34 77	199 80	....	24 71
Oregon	29 70	18 52	21 75	16 56	22 96	43 28	66 99	....	17 47
Nevada	43 75	35 25	30 09	26 97	30 80	30 25	160 08	....	30 37
The Territories	35 54	31 09	28 52	25 74	29 59	28 50	143 55	....	24 73

Total average cash value per acre of the above crops for the year 1870.

States.	Average value per acre.	States.	Average value per acre.
Maine	$19 55	Texas	$18 12
New Hampshire	22 76	Arkansas	24 31
Vermont	17 43	Tennessee	12 25
Massachusetts	32 15	West Virginia	16 03
Rhode Island	28 94	Kentucky	15 00
Connecticut	36 35	Missouri	11 17
New York	22 52	Illinois	12 03
New Jersey	26 28	Indiana	13 61
Pennsylvania	18 93	Ohio	17 03
Delaware	15 91	Michigan	16 96
Maryland	15 71	Wisconsin	14 13
Virginia	13 55	Minnesota	12 59
North Carolina	12 87	Iowa	10 65
South Carolina	10 29	Kansas	13 87
Georgia	12 54	Nebraska	10 51
Florida	14 63	California	24 82
Alabama	16 31	Oregon	19 03
Mississippi	16 50	Nevada	35 48
Louisiana	25 49	The Territories	31 94

NUMBER AND CONDITION OF FARM STOCK.

The experience of the winter of 1870–'71 proves that a little foresight, directing the way to judicious management, will often remedy the deficiencies of production. Thus, the comparatively short crop of hay (which was seriously light in the East and in portions of the West) led to the husbanding of immense quantities of corn-fodder and to the utilizing of masses of straw for feeding purposes; to the gathering of larger quantities of the wild hay on the borders of the numerous lakelets of the Northwest, and the cutting of larger areas of prairie grass, so that the animals of the farm, consigned by the timid and the croaking to semi-starvation or the knife, went through winter-quarters in higher flesh and better health than for several years past. It is true that, in sections in which scarcity was most apparent, beeves were sent to the shambles in larger numbers and lighter condition than usual; but the relief came mainly from care in feeding, avoidance of waste, and the use of coarse feed, so abundant at all times, and generally so little utilized. Some credit should be given, however, to providential mildness of the weather, which reduced the consumption of fodder, and in some northern latitudes permitted an unaccustomed bite of grass. The past season has furnished new evidences of the capacity of this country as a meat producer, and the extent of its feeding resources ordinarily wasted; especially has it illustrated the surpassing value of our corn crop.

The county returns showing the condition of domestic animals during the year have borne a remarkable uniformity in their exemption from croaking and depressing views; and while they exhibit great variety in description of the status of domestic animals, nine-tenths of them have indicated a state of health and vigor varying from medium to highest.

It has been necessary, on each recurring annual investigation relative to farm stock, to chronicle an amount of animal suffering, disease, and death, disagreeable in the recital, burdensome as a tax upon industry, and much of it unnecessary as it is expensive. Neglect and exposure, habitual and almost universal in the barnless sections of the country, and too common in the more recent settlements of the colder Northwest, have cost the farmers of the country millions annually. The past season has been favorable, and more humane and economic views are beginning to obtain; a large preponderance of the returns concur in this view, and many of them bring cheering evidence of more rational practices in the treatment of domestic animals. Even where hay was scarce, as in Grand Isle County, Vermont, "extra care and attention more than offset the reduced quantity of fodder." It is gratifying to notice as one of the reasons for less mortality in the Northwest "the more general erection of warm shelters," as in Fillmore County, Minnesota. While cattle "do well," as is frequently reported, without any shelter prepared by the hand of man, even in the Rocky Mountain valleys, there is no certainty of such exemption from suffering and death either in the Territories, in Texas, or in Louisiana. In the latter, an almost tropical region, the return for Washington Parish says: "The severity of the winter caused considerable disease in stock, and the survivors, depending on the woods, barely lived, as a general thing."

Losses of the year.—The actual mortality from exposure and disease was probably not half as great in 1870 as in 1869. A majority of the counties return a very favorable comparison with the report of last spring; some estimate one-half as much loss, others one fourth, and many correspondents assert that they have heard of no losses what-

ever. This is the case in no less than eight counties in Indiana. In Hillsborough, New Hampshire, there has been "less than for five years." The correspondent in Franklin, Pennsylvania, says he "never heard of so little."

A few counties report an increase of mortality; among them McDuffie, in Georgia; Fayette, (50 per cent. greater from cold rains and scanty pasturage,) Bell, (less in sheep, more in cattle,) Milam, (50 per cent. loss from destruction of grass and drowning,) Galveston, and Leon, in Texas; Benton, Arkansas; Upshur, West Virginia; Marshall, (25 per cent. greater than last year,) Illinois; Barry, (owing to smutty corn,) Michigan; Meeker, Minnesota; Lake, California, (three times as great;) Alameda, (scarcity of food,) Stanislaus, (severity of the winter,) Tuolumne, San Joaquin, in the same State.

DISEASES OF CATTLE.

Splenic fever.—The "Texas cattle disease" has had few opportunities to display its malignity since the isolation and winter pasturage of droves in Western Kansas. It has been found unprofitable and impracticable to introduce them by boats via New Orleans and the Mississippi River, and the trade has quietly accommodated itself to what was a necessity, and at the same time a convenience and economy.

A few facts illustrate the capabilities for mischief of the splenic infection, and show how easily havoc might be spread again among the herds of the West. The following statement is from—

Lincoln County, Kentucky.—There was a car-load of cattle brought here from Memphis, Tennessee, about the 1st of July, and after being here a few days seven of them died. The cattle in the pasture were taken out, and nothing more was heard of the disease until the middle of October, when it again broke out among the native cattle that had been pastured on the same grass, and some sixteen others died, and it again entirely ceased about Christmas. It was supposed that the cattle were partly Texas cattle, and that the disease was Texas fever.

The report from Madison County, Illinois, asserts that a drove of Texas cattle lost about ten head by what was supposed to be Spanish fever. The disease extended to native cattle and to hogs, which are supposed to have eaten of the carcasses of the Texan beeves. This statement is at variance with common experience as to the effects of the diseased meat upon swine. The correspondent in Floyd County, Indiana, says: "No Spanish fever has prevailed. Notwithstanding all that has been said on the subject, our people believe that the disease was brought here by Texas cattle, for it prevailed terribly year before last, when hundreds of southern cattle grazed in the county. This year we have not had a case." In Uvalde County, Texas, a loss of 12 per cent. from Spanish fever is returned. It is stated that cattle became much diseased in 1868, and "observation proved the disease to be contagious," and that change of range tends to restoration to health. In Clark County, Arkansas, several cattle were lost by being pastured in a field where a drove of Texas cattle had been. No disease was noticed in the drove. The report from Independence County, while showing exemption from splenic fever during the past year, refers to the fearful ravages in 1868, by which the native cattle were nearly exterminated. Laws prohibiting the passage of Texas cattle have since kept the disease from the county. A few cases occurred in Butler, Crawford, Montgomery, and Neosho, in Kansas, and a larger number in Johnson. In Linn, Missouri, ninety-five died from feeding on the track of a drove of Texas cattle. In St. Louis a few cases occurred where Texas cattle had been pastured. A drover in Cole County, who supplied

the State penitentiary with beef, drove some Texas cattle from the railroad depot to his pastures, a few miles from town. On the way some of the town cattle became mixed with the drove and were driven rapidly to the pasture, where they were separated and set free from the Texas herd. A few days after this occurrence those town cows commenced showing symptoms of Texas fever, and twelve head of them died. The disease was not communicated from these natives to others grazing with them. The drover in question promptly paid the losses without litigation. Another case occurred among the herd of Dr. McWorkman. It was introduced on his place by some Texas steers, bought by him for fattening, and caused severe loss. Fifty cases, all fatal, originated from Texas cattle herded and pastured in Pettis County, last August. Our correspondent in Vernon County makes the following statement:

Two droves inoculated the native cattle. They came into the county in June. One was owned by a citizen, and remained about five weeks; the other was driven through by strangers. Both claimed that their cattle were wintered in the State, but did not show proof of the fact. The drove first mentioned were herded near Nevada, the county seat. As soon as the fever broke out among the native cattle they were shipped, yet the fever continued to spread, through the neighborhood in which they were herded, until frost, killing two hundred and twenty-five head, valued at $9,000, being at or about 80 per cent. of those exposed. The second drove, in attempting to pass through, were stopped near Montevallo, a town eighteen miles east of Nevada, for a day and part of a night. In about four weeks the fever appeared. The loss here was two hundred and sixty head, mostly oxen and milch cows, valued at $11,700. Ninety-two per cent. of the cattle exposed died. The excessive drought made the fever more fatal than usual, few or none recovering. The following facts in relation to this fever are well known here; we have been familiar with the fever for seventeen years:

First symptom, several days before any other appearance of sickness, is a dry cough, particularly when not feeding. Second. More flies collect on them; at this time the breath will have lost its sweetness. Third. Ears slightly droop; eyes look dull. Fourth. Nose dry; appetite poor; languor; cough ceases. Fifth. Fever commences; ears hang; appetite gone; reel in walking in hind parts; do not follow the herd. Sixth. Eyes sink; a feverish, slaughter-house smell; generally on feet, but seldom move. Seventh. Hair appears dead, as on dry hide; death with few struggles. Some pass bloody water; feces of brown color, but plentiful. In others no change from health can be discovered, excepting the brown color of the feces; while others are costive. In these the feces are very dark, small, and dry.

In Putnam, Illinois, eighteen steers (three years old) died within three days in a pasture which had been occupied by Texas cattle the previous winter. In Bureau County, into which a considerable number of Texas cattle were driven last summer, one hundred and twenty-five to one hundred and fifty fatal cases are reported. Our correspondent for Jasper County, Iowa, reports a loss of 3 per cent. of their cattle from Spanish fever. In the stock-yards of Lake County, Ohio, into which southern and western cattle are brought, deaths have occurred, but it is not certain that they were caused by splenic fever. In Fauquier, Virginia, the disease followed the introduction of Texas cattle, and large numbers of native cattle died. The same result followed a like course in Knox County, Tennessee; and the fever is reported also in Surry and Burke, North Carolina, and in a few counties in Northern Georgia.

Foot and mouth disease.—Epizoötic aphthæ, for the first time in the history of cattle diseases of this country, has prevailed to a limited extent in parts of New York, and in several localities in New England. The losses resulting have been a deterioration in condition and decrease of milk production, rather than actual mortality. The subject is treated at length in another portion of this volume.

Disease from smut in corn.—A considerable loss has been attributed to smut in corn in several of the Western States. In some instances the

exciting cause is assumed to be eating of large quantities of corn-stalks without a sufficient supply of water. A herd of one hundred and two steers, all in apparent health, were taken from a poor pasture and put in a fresh stalk-field in Marshall County, Illinois, and fourteen were found dead the next morning, and five more on the following morning. In Dane County, Wisconsin, a number of deaths occurred after the cattle were turned into the stalk-fields. In Kansas losses were heavy from this cause; two hundred died in Coffey County, and some in Shawnee and Osage. The report from Jackson, Iowa, attributes losses to the corn-stalks, "causing engorgement of the paunch, and laceration, inflammation, and death;" and similar loss appears in Black Hawk, Bremer, Harrison, Lee, Chickasaw, and Delaware; in the latter, "*post mortem* examination discloses in the folds of the stomach a dark substance, similar to smut, which it is believed to be." In Hillsdale and Barry, Michigan, in Holt, Missouri, and in Houston, Minnesota, similar effects of eating stalks are reported. In Roanoke, Virginia, one-eighth of the young cattle have died, "supposed to be caused by grazing in wheat-fields."

Pleuro-pneumonia, for several years so fatal in the vicinity of Baltimore and the District of Columbia, and to some extent in the neighborhood of Philadelphia, has been less prevalent during the past season.

Black leg.—This disease occasions the death of many young cattle each spring, in every section of the country, generally attacking those in good condition, and ending in death. It is not reported in New England; in New York a few cases are mentioned in Ontario and Chautauqua; in Albermarle and Highland, Virginia; in Harrison, West Virginia; in Mercer, Ohio, twenty fatal cases; a few deaths in Noble, Ohio; several fatal cases in Winona and McLeod, Minnesota; in Iowa, losses in Chickasaw, Plymouth, and Jackson; considerable loss among young cattle in Nemaha, Pawnee, and Washington, Nebraska; and many fatal cases in Coffey, Howard, Riley, and Shawnee, Kansas.

Charbon.—This virulent disease has nearly disappeared from the South. The report from St. Mary's Parish, Louisiana, says: "Malignant pustule, or *charbon*, carried off twelve mules on one plantation."

Murrain.—It is to be regretted that a more accurate knowledge of cattle diseases does not exist among the farmers of the country. The use of the words "murrain," "dry murrain," "bloody murrain," and "distemper," is common in the reports, and other meaningless terms are applied to diseases having a great diversity of symptoms.

Among all the diseases named, perhaps *starvation*, with its various aliases, as "general debility," "hollow-horn," "horn-ail," or "hollow-belly," is productive of greater loss than any other. Neglect, exposure, insufficient or irregular feeding, and no feeding whatever, are prolific causes of weakness, disease, prostration, and death.

DISEASES OF HORSES.

Diseases among horses have not been unusually prevalent or fatal. Comparatively few cases are reported from northern latitudes. The most frequent mention is made of "blind staggers," which has prevailed in Berks County, Pennsylvania, Calvert and Queen Anne's, in Maryland; Sampson, Tyrrell, Duplin, Hertford, and Orange, North Carolina; Bartow, Richmond, and Walker, Georgia; Calhoun and Etowah, Alabama; Uvalde, Rusk, and Red River, Texas; Benton, Arkansas; Sevier, Meigs, Coffee, Monroe, Jefferson, Robertson, and Knox, Tennessee; Butler, Cedar, Newton, and Taney, Missouri. Lung fever is noticed in Indiana County, Pennsylvania, in the lumbering region, and in Beaver

and Montgomery; in Gloucester, New Jersey, with more than usual fatality; in Kent, Maryland, of a mild type; in Princess Anne, Virginia; Cass, Missouri, a few cases; Geauga and Medina, Ohio; Cass and Tuscola, Michigan; and Stearns, Minnesota. In Fulton County, New York, a catarrhal affection, accompanied by croup, resulted in death in a few cases. Glanders is less known than formerly; a few cases are reported in Nelson, Montgomery, Patrick, and Fauquier, Virginia; in Meriwether, Georgia; in Hardin, Texas, it has been worse than ever before; and in Noble, Ohio, a few cases are returned. In several counties in Texas something like scours, in an epidemic form, has been fatal. It is stated that opium and camphor, administered early, is a very efficient remedy. Three per cent. of the horses in Prairie County, Arkansas, have yielded to the insect pest—the buffalo gnat. In Pike County, Illinois, an unknown disease, which has been fatal in some cases, has for its symptoms stiffness of limbs, sore mouth, and swollen tongue. Many horses in Williamson County, Illinois, are afflicted with blindness. "Distemper" is reported in many places, and isolated cases of tetanus or lock-jaw, yellow water, colic, and other forms of disease are reported. The following extracts further illustrate this subject:

Hampden, Mass.—A number of horses have died in one stable in Chicopee. Symptoms: first, loss of appetite, which returns in a few days; bunches as large as walnuts come out on different parts of the body, and break and discharge putrid matter; legs swell; in three or four days there is a discharge at the nose similar to that from the sores. Fatal in five to seven days. No cases of recovery. The disease was introduced by a horse from Canada.

Washington, Penn.—Distemper exists to some extent; also a malady called the "throat disease," or the "head disease;" six deaths occurred from it. Horses when attacked refuse food or drink until half starved; when the throat was much swollen, eyes dull and heavy, head drooping; if forced to move, holding it in one position with nose up and forward, as if it pained them to move the head; they would then eat nothing but choice food, swallowing with difficulty. Various horse liniments were used; many cures were effected.

Doddridge, West Va.—Some unknown disease. Symptoms: swelling of the jaws and head, which terminates in running sores; the animal refuses to eat, loses flesh rapidly, and soon dies; no known remedy.

Wilkinson, Miss.—A disease called "distemper," very contagious, malignant, and fatal, has prevailed for three months in a part of this and Amite County, and adjacent parts of Louisiana. A difficulty in drinking, swelling over the nasal canal, and discharges from the nostrils are among its symptoms. A remedy is found in bathing the tumors with kerosene till they open, with good care and feed.

Lee, Texas.—A kind of farcy has proved quite fatal. It commences under the jaw and spreads over the entire body, accompanied with slow fever. The loin distemper is quite prevalent among horses on the prairies. It is contagious between the sexes.

Victoria, Texas.—Several cases of a disease which commenced with a swelling of the head, particularly about the lips; considerable secretion of water from the eyes; wasting of the flesh; no eruptions of the skin. Of six cases, three proved fatal, after lingering six to eight months, losing the hair from their manes and tails several months before death.

Williamson, Texas.—For the past three or four years, in this and adjoining counties, at least one-half of the colts have died before two years old. I know of no name or remedy for the disease. It runs through the young stock in the fall, and what it does not then kill generally die in the winter. They become stiff in the legs, and walk with difficulty. Many of them swell about the head and breast, until the swelling breaks and discharges bloody water. At such times flies are apt to blow the sores, and if not attended to in season the screw-worm will kill the animal. Calomel is the best remedy I have used to destroy these worms; one or two applications to the wound will generally suffice. Horses, cattle, sheep, dogs, and, in fact, all animals, are liable to be destroyed by this pest in the fall season. When wounded, from any cause, the flies soon find the fresh blood, and deposit germs of myriads of worms, which, in a few days, are full grown and about half an inch long. This is a critical time with the stock-raiser, for if not attended to early the evil is much more difficult to cure.

Dunn, Wis.—Last fall the influenza took off a great many colts in some localities. In one neighborhood about thirty died. They were pastured on the common, where there is plenty of unimproved land, and it was supposed by some that the disease originated from the drinking of stagnant water in a lake in the vicinity.

Waushara, Wis.—There has been a disease among horses, from which quite a number have died. The horse's throat seems to swell and close up the passage. It is a new thing for this county, and no one knows how to treat it successfully.

Napa, Cal.—Dr. Lockwood reports a disease as follows: "A disease, familiarly called the 'crazy disorder,' has prevailed to some extent among common stock horses, coming from the southern counties of this State, where it has existed for some years. It is characterized by a low state of the system, induced by poor feed. Head symptoms are predominant; animals attacked often die, and probably none ever recover their normal condition. One so diseased is worthless; will not repay further care. Mr. N. Coombs has lost fifty head this winter, exclusively among his inferior stock." The horses referred to are what we here call Spanish horses, and are usually left in large bands, without special feed or care, like the wild horse of Mexico.

DISEASES OF SHEEP.

Diseases of sheep are less general than for two or three years past, mortality and the slaughtering-house (in former years) having reduced the numbers of the weak and diseased victims of neglect. Foot-rot is still the most prolific source of loss, most abundant in Ohio, severe in portions of Michigan, and found to some extent in other Western and in the Middle States, with very few cases in New England and the South, and none in the Territories and Pacific States. Scab is most general in Texas, is reported in several counties in Missouri, and is occasionally found in all sections east of the Mississippi, though few cases are reported in the Atlantic States east and south of New York. Rot has occasioned some loss in Alabama and Mississippi. "Grub in the head" has been reported in very few counties. A Georgia correspondent (Dooley County) reports 5 per cent. loss from "a new disease, the sore nose." It is a frequent report that there is no disease among sheep that are well fed and properly treated. Cruel neglect and reckless disregard of the comfort and health of flocks account for nearly all the losses reported. In Montgomery County, Maryland, native sheep have been healthy; of 1,200 Merinos brought from Ohio here fully three-fourths have died. In Marion, South Carolina, lambs dropped last spring became unhealthy, and one-third have died. In Caldwell, North Carolina, when kept in pasture of small area several successive years, they become affected with rot in many cases. In Washington, Pennsylvania, three-fifths of the sheep have foot-rot. The ravages of dogs are perhaps more injurious to sheep husbandry than any disease named above. The returns are full of evidence on this point. The counties in North Carolina that report the dog disease equal in number those which name ailments of sheep. In Virginia "dogs are more destructive than all diseases." In Marshall County, Alabama, the loss is 30 per cent. from "starved dogs." In Georgia it is stated that "the dog is the worst disease afflicting flocks," and that "few farmers raise sheep on account of dogs."

DISEASES OF SWINE.

The diseases among swine, however various, are popularly referred to "hog cholera," as a rule. Whenever symptoms are detailed in the returns, they are given as aids in determining the character of the malady. The losses reported are less this spring than usual, indicating far greater soundness of health than in some former years. There is still more of disease and death among swine than in any other class of farm animals, and probably less is accurately known of the character of the maladies afflicting the species. Having superior care and better feed in the Middle and Eastern States, there is comparatively little loss reported in those sections. In York County, Maine, some cases of disease have been reported among improved breeds. The preventive practice of feeding a tablespoonful of spirits of turpentine in milk to a hog over six months obtains in Chautauqua, New York. Some loss is mentioned in Columbia

County. Stock hogs from Indiana have sickened in York, Pennsylvania, and 30 per cent. of that class have died. Abortion has prevailed in Dauphin, attributed to over feeding with unground corn. Two hundred and fifty pigs under six months old have died in Washington, the remedies applied being salt and alkaline substances; and some fatality is reported in Cumberland, Perry, Indiana, Beaver, Union, Fulton, and Berks. In Montgomery, Maryland, one-half to three-fourths of the hogs in certain neighborhoods have died. The loss in Howard is estimated at three thousand, and slight losses have occurred in Baltimore and Kent. In portions of Gloucester, Virginia, disease has nearly swept away the race of swine; in a portion of Clark 70 to 80 per cent. have died; loss 25 per cent. in Fairfax; some unknown disease has carried off numbers in Princess Anne, and losses have occurred in Albemarle, Roanoke, Pulaski, Northampton, Cumberland, Nelson, Lee, Prince William, Highland, Lancaster, Surry, Smyth, and Patrick. A considerable amount of mortality is reported from North Carolina; a loss of 50 per cent. is declared in Wautauga County; from 50 to 75 per cent. in certain stocks in Currituck; 40 per cent. in portions of Chowan; large numbers from a new disease, "of a lung-fever type," in Gaston; 20 per cent. of the fattening swine in Haywood; 33 per cent. in Rowan; 25 per cent. in Davie; 20 per cent. in Lincoln; 30 per cent. in Greene; nine out of every ten attacked in Yadkin; 20 per cent., mostly near fruit distilleries, in Stanley; 33 per cent. in Alexandria; and smaller losses in Sampson, Union, Surry, Tyrrell, Duplin, Rockingham, Jackson, Macon, Caldwell, Rutherford, Wilkes, Hertford, Burke, and Orange. Great fatality, involving three-fourths of the entire stock of Newberry, South Carolina, is reported, and small losses are mentioned in Spartanburgh and Lexington, in the same State. Georgia has suffered little loss; 50 per cent. is reported in Clinch, 30 in Morgan, and small losses in Bartow, McDuffie, Lumpkin, Jackson, Harris, Catoosa, Floyd, Butts, Forsyth, Towns, Pike, Walker, Clay, Milton, Clayton, Putnam, Newton, Pulaski, White, Franklin, and Heard. Our correspondent in Dallas, Alabama, lost forty-four out of fifty-six old hogs; pigs were not so generally attacked. In Lawrence a loss of 25 per cent. is returned, but the mortality was reported slight in Tallapoosa, Marshall, DeKalb, Calhoun, Clarke, Jefferson, and Etowah. Very little disease among swine is reported in Mississippi; a few cases have occurred in the following counties: Attala, Kemper, Neshoba, Pike, Amite, Tippah, Yalabusha, Yazoo, La Fayette, Winston, and Carroll. In Gonzales, Texas, a disease, assumed to be "an affection of the lungs," carried off most of the pigs and a few hogs. The fattest were first to fall; of a litter of pigs, fat and apparently healthy at night, half would sometimes be found dead in the morning. In Upshur, a loss of one-tenth of the pigs is attributed to carelessness in permitting them to eat *ad libitum* freshly-ground cotton-seed. A few losses appear in Austin, Collins, Harris, and De Witt. There is scarcely a live pig in Benton County, Arkansas, the result of a cough and wasting away. A loss of 20 per cent. is returned from Newton County. Large losses occurred in Clarke, attributed to "too much cotton, and want of corn." One-third of the stock in Jackson County died, generally in full flesh. Losses are also reported in Johnson, Montgomery, Pulaski, Sebastian, and Washington. Less mortality than usual has occurred in Tennessee, very few counties reporting heavy losses, among which are Humphreys, 60 per cent.; Smith, 50 per cent. of all hogs since November; and Greene, 40 per cent.; smaller losses appear in Sumner, Sevier, Meigs, Williams, Giles, Weakley, Campbell, Coffee, Sullivan, Montgomery, Monroe, Henry, Jef-

ferson, Johnson, Robertson, Hardiman, and Hickman. In Morgan, West Virginia, half of the pigs and one-fifth of the fattening hogs died last fall, and the disease is commencing its ravages this spring. Losses are also reported in Berkeley, Brooke, Cabell, Fayette, Jefferson, Tyler and Wayne. In Anderson, Kentucky, the loss is estimated at five hundred head; in Hardin, 33 per cent., and the disease still spreading; in Bourbon, $5,000; in Whitely, 50 per cent.; very heavy in Clarke; while in Christian the loss is placed at 25 per cent., 20 per cent. in Kenton and Laurel, about the same in Graves, and less in Shelby, Hopkins, Scott, and Warren. In Clarke, Missouri, the loss is estimated at 50 per cent., "confined principally to pigs up to six months old;" "many deaths from insufficient shelter, but all attributed to cholera," is written from Bates; loss one thousand head in Holt, three hundred and seventy-five in Bates, two hundred in Pettis, and small percentages of loss in Benton, Cass, Dent, Butler, De Kalb, Montgomery, Marion, Mercer, and Vernon. Thirty-six counties in Illinois report losses from diseases of swine, though the damage is comparatively slight, with few exceptions. In Washington disease has more generally prevailed, and has been attended with greater loss than for many years; losses have been quite heavy in portions of Sangamon; are estimated at three thousand in Cass; four hundred and fifty head in Clinton; 25 per cent. in Scott; 20 per cent. in White and McDonough; 15 per cent. in Menard; 10 per cent. in Edwards, "prevailing almost exclusively in rolling districts;" and is also reported in Adams, Crawford, Champaign, De Kalb, Franklin, Fulton, Grundy, Hancock, Henderson, Jersey, Knox, Lawrence, Logan, Mercer, Marion, Madison, Morgan, Pope, Pike, Stephenson, Stark, Piatt, Pulaski, White, and Warren. The loss from hog cholera or other maladies in Indiana is less than usual. In Union County "disease has entirely disappeared" within the last twelve months; it has almost disappeared in Rush; is found "only in the vicinity of flouring mills and distilleries" in Switzerland; "loss small compared with other years" in Harrison; Vandenburgh "has not been so free for twelve years;" has not been so destructive as formerly in Marion, "though one-fifth of all the young die;" since July there has been less complaint in Bartholomew than for several years; loss in Cass has been two hundred head; it amounts to one-third of the young in Posey; and losses have occurred in Floyd, Wabash, Howard, Jefferson, Martin, Newton, Pike, Washington, Carroll, Ripley, Delaware, Clinton, Greene, Parker, Miami, Scott, Spencer, Vermillion, Sullivan, Gibson, and Ohio. Ohio appears to have been nearly exempt from hog cholera; at a distillery in Lucas from three hundred to four hundred head died; about one-fifth of the swine brought into Greene from Indiana for fattening have been attacked, and a few cases are reported in Jefferson, Holmes, Warren, Fairfield and Franklin. The swine of Michigan are reported healthy, only one county, Cass, returning losses, which have amounted to one or two hundred in a locality. A disease of the throat is reported in Green County, Wisconsin, where it has prevailed to a limited extent. Of twenty counties reporting in Minnesota, Meeker only presents evidences of disease, in which forty pigs were lost, "caused by filth and improper food, and not from any cause beyond the pen in which they were confined." Small loss is reported in Iowa; in Louisa County, 25 per cent.; one hundred and fifty head in Lucas; one hundred head in Clarke; and in Black Hawk, Lee, Wayne, Frémont, Dallas, Jasper, Tama, Appanoose, Madison, and Bremer, a few cases are mentioned. Only Nemaha and Cass, in Nebraska, report losses, and Leavenworth, in Kansas.

Table showing the estimated total number and total value of each kind of live stock, and the average price in February, 1871.

States.	HORSES.			MULES.			OXEN AND OTHER CATTLE.		
	Number.	Average price.	Value.	Number.	Average price.	Value.	Number.	Average prices.	Value.
Maine	83,000	$86 38	$7,169,540	....	....	....	191,900	$36 98	$7,070,576
New Hampshire	49,500	89 29	4,419,855	....	....	....	133,000	36 62	4,870,460
Vermont	71,000	97 49	6,921,790	....	....	....	140,600	42 80	6,017,680
Massachusetts	99,900	129 89	12,976,011	....	....	....	122,700	44 66	5,479,782
Rhode Island	15,300	98 19	1,502,307	....	....	....	18,800	51 91	975,908
Connecticut	51,500	102 85	5,296,775	....	....	....	128,700	45 57	5,864,859
New York	652,800	102 49	66,905,472	19,300	$124 23	$2,397,639	705,000	42 27	29,800,350
New Jersey	115,800	130 00	15,054,000	14,800	140 00	2,072,000	84,100	45 06	3,789,546
Pennsylvania	540,700	106 92	57,811,644	25,200	132 51	3,339,252	760,900	41 41	31,508,869
Delaware	20,000	89 99	1,799,800	4,000	130 99	523,960	31,900	25 70	819,830
Maryland	102,500	90 52	9,278,300	10,800	123 86	1,337,688	125,700	27 21	3,420,297
Virginia	178,500	84 93	15,160,005	29,400	108 93	3,202,542	397,800	21 34	8,489,052
North Carolina	126,700	90 41	11,454,947	44,400	114 43	5,080,692	298,400	10 68	3,186,912
South Carolina	53,800	101 97	5,485,986	42,300	108 25	4,578,975	174,400	12 08	2,106,752
Georgia	112,800	109 15	12,312,120	88,300	131 64	11,623,812	409,500	10 80	4,422,600
Florida	16,200	121 36	1,966,032	9,900	99 66	986,634	412,000	8 17	3,366,040
Alabama	103,600	99 34	10,291,624	98,700	116 93	11,540,991	324,900	12 34	4,009,266
Mississippi	82,100	104 22	8,698,572	96,300	127 74	12,301,362	333,500	14 59	4,865,765
Louisiana	70,800	91 29	6,463,332	75,500	134 79	10,176,645	172,600	15 62	2,696,012
Texas	615,700	32 29	19,880,953	82,900	52 30	4,335,670	3,220,000	7 37	23,731,400
Arkansas	138,100	73 98	10,216,638	67,900	93 51	6,349,329	221,900	11 82	2,622,858
Tennessee	280,000	84 48	23,654,400	94,600	105 51	9,981,246	338,100	14 77	4,993,737
West Virginia	97,800	81 83	8,002,974	2,300	92 08	211,784	233,200	29 81	6,951,692
Kentucky	287,400	75 05	21,571,370	85,500	82 73	7,073,415	400,400	31 10	12,452,440
Missouri	483,100	63 61	30,723,630	83,400	83 43	6,958,062	731,100	24 46	17,882,706
Illinois	1,008,800	70 26	70,878,288	96,900	85 18	8,253,942	1,224,000	26 02	31,848,480
Indiana	650,000	72 38	47,047,000	35,700	74 33	2,653,581	750,000	26 16	19,620,000
Ohio	724,200	79 48	57,559,416	22,200	83 36	1,850,592	800,700	35 34	28,296,738
Michigan	274,500	79 69	21,874,905	4,200	93 08	390,936	450,000	31 65	14,242,500
Wisconsin	310,200	79 87	24,775,674	4,800	106 55	511,440	388,500	26 86	10,435,110
Minnesota	119,900	79 13	9,487,687	2,700	104 15	281,205	228,900	22 75	5,207,475
Iowa	570,400	71 15	40,583,960	34,400	83 24	2,863,456	814,900	24 05	19,598,315
Kansas	156,000	72 15	11,255,400	14,900	92 14	1,372,886	345,600	28 84	9,967,104
Nebraska	36,200	83 05	3,006,410	3,400	119 35	405,790	54,500	29 95	1,632,275
California	204,800	50 26	10,293,248	21,400	68 44	1,464,696	490,000	26 92	13,190,800
Oregon	73,400	54 29	3,984,886	4,200	50 82	213,444	102,000	21 69	2,212,380
Nevada	8,600	58 66	504,476	1,000	75 00	75,000	26,700	30 60	817,020
The Territories	76,000	53 66	4,078,160	21,000	84 72	1,779,120	426,000	26 94	11,476,440
Total	8,702,000	....	623,257,587	1,242,300	....	126,127,786	16,212,200	....	369,940,056

Table showing the estimated total number and total value of each kind of live stock, &c.—Continued.

States.	MILCH COWS.			SHEEP.			HOGS.		
	Number.	Average price.	Value.	Number.	Average price.	Value.	Number.	Average price.	Value.
Maine	141, 300	$36 37	$5, 139, 081	415, 000	$2 73	$1, 132, 950	67, 600	$9 87	$667, 212
New Hampshire	95, 000	37 50	3, 562, 500	234, 000	2 35	549, 900	47, 200	17 78	839, 216
Vermont	193, 900	47 50	9, 210, 250	518, 000	2 62	1, 435, 760	66, 700	17 00	1, 133, 900
Massachusetts	139, 300	59 16	8, 240, 988	72, 000	3 26	234, 720	84, 800	15 55	1, 318, 640
Rhode Island	21, 900	44 25	969, 075	30, 000	3 71	111, 300	20, 400	14 62	298, 248
Connecticut	110, 200	53 50	5, 895, 700	81, 000	4 07	329, 670	69, 300	18 75	1, 299, 375
New York	1, 411, 100	48 51	68, 452, 461	2, 080, 000	3 14	6, 531, 200	658, 800	11 09	7, 306, 092
New Jersey	145, 000	61 38	8, 900, 100	127, 400	4 81	612, 794	156, 000	15 45	2, 410, 200
Pennsylvania	788, 900	46 67	36, 817, 963	1, 762, 500	3 16	5, 569, 500	1, 047, 600	10 72	11, 230 272
Delaware	26, 000	35 00	910, 000	25, 300	3 75	94, 875	46, 000	6 25	287, 500
Maryland	96, 000	39 09	3, 752, 640	135, 000	3 86	521, 100	259, 200	7 76	2, 011, 392
Virginia	229, 500	29 09	6, 676, 155	394, 800	2 37	935, 676	757, 500	5 60	4, 242, 000
North Carolina	203, 400	22 57	4, 590, 738	315, 200	1 63	513, 776	841, 500	4 15	3, 492, 225
South Carolina	147, 500	23 22	3, 424, 950	156, 700	1 95	305, 565	317, 200	4 69	1, 487, 668
Georgia	252, 500	21 61	5, 456, 525	269, 500	1 65	444, 675	1, 428, 900	4 64	6, 630, 096
Florida	73, 500	15 83	1, 163, 505	30, 800	1 31	40, 348	180, 000	2 75	495, 000
Alabama	177, 200	24 50	4, 341, 400	200, 200	1 77	354, 354	900, 000	4 30	3, 870, 000
Mississippi	182, 000	25 34	4, 611, 880	200, 000	2 00	400, 000	850, 000	4 40	3, 740, 000
Louisiana	90, 000	24 62	2, 215, 800	90, 000	2 18	196, 200	300, 000	4 30	1, 290, 000
Texas	596, 500	12 83	7, 653, 095	1, 137, 300	1 40	1, 592, 220	1, 200, 000	2 76	3, 312, 000
Arkansas	132, 600	22 14	2, 935, 764	135, 000	2 32	313, 200	863, 600	3 28	2, 832, 608
Tennessee	233, 600	23 57	5, 505, 952	400, 000	1 66	664, 000	1, 520, 000	4 49	6, 824, 800
West Virginia	117, 300	34 73	4, 073, 829	562, 600	2 11	1, 187, 086	319, 000	4 80	1, 531, 200
Kentucky	227, 200	38 14	8, 665, 408	904, 300	2 53	2, 287, 879	1, 991, 100	4 81	9, 591, 621
Missouri	371, 200	31 92	11, 848, 704	1, 578, 200	1 61	2, 540, 902	2, 200, 000	4 34	9, 548, 000
Illinois	683, 400	37 68	25, 750, 512	1, 424, 000	1 98	2, 819, 520	3, 363, 000	7 52	25, 289, 760
Indiana	435, 500	38 50	16, 766, 750	2, 100, 000	1 82	3, 822, 000	2, 349, 000	6 04	14, 187, 960
Ohio	734, 400	45 09	33, 114, 096	4, 641, 000	2 26	10, 488, 660	2, 033, 000	7 89	16, 040, 370
Michigan	333, 900	41 15	13, 739, 985	3, 072, 800	2 23	6, 852, 344	517, 400	7 37	3, 813, 238
Wisconsin	386, 200	35 26	13, 617, 412	1, 056, 000	2 44	2, 576, 640	651, 900	7 93	5, 169, 567
Minnesota	153, 600	32 91	5, 054, 976	140, 000	2 22	310, 800	177, 000	6 61	1, 169, 970
Iowa	465, 300	34 31	15, 964, 443	1, 822, 700	1 71	3, 116, 817	3, 100, 000	7 15	22, 165, 000
Kansas	162, 000	38 46	6, 230, 520	115, 000	2 53	290, 950	304, 800	8 88	2, 706, 624
Nebraska	34, 800	41 81	1, 454, 988	26, 700	2 24	59, 808	76, 200	8 58	653, 796
California	186, 800	46 36	8, 660, 048	3, 636, 000	2 59	9, 417, 000	459, 000	5 94	2, 726, 460
Oregon	62, 400	32 25	2, 012, 400	419, 200	1 90	796, 480	149, 500	2 51	375, 245
Nevada	7, 100	50 00	355, 000	12, 800	4 31	55, 168	4, 300	7 49	32, 207
The Territories	175, 000	36 82	6, 443, 500	1, 500, 000	3 02	4, 530, 000	77, 000	7 57	582, 890
Total	10, 023, 000	....	374, 179, 093	31, 851, 000	....	74, 035, 837	29, 457, 500	....	182, 602, 352

LIVE-STOCK MARKETS.

NEW YORK.

The live-stock trade of New York has grown into mammoth proportions, having much more than doubled within the last ten years. The sources of supply have also greatly changed. Ten years ago the market was chiefly supplied by New York and neighboring States; now, as far as cattle are concerned, New York ranks fifth in point of production. The West furnishes the great bulk of all descriptions of live stock.

In 1860 there were received in this market, 226,933 cattle; 5,749 cows; 32,368 calves; 512,366 sheep; 559,421 hogs—total, 1,386,837. In 1868, 293,101 cattle; 5,382 cows; 82,935 calves; 1,400,623 sheep; 976,511 hogs—total, 2,758,552. In 1869, 325,761 cattle; 4,836 cows; 93,984 calves; 1,479,563 sheep; 901,308 hogs—total, 2,805,452.

The receipts during the year 1870 were as follows:

Cattle	356,026	Sheep	1,463,878
Cows	5,050	Hogs	889,625
Calves	116,457		
		Total	2,831,036

Weekly average: Cattle, 6,847; cows, 97; calves, 2,240; sheep, 28,151; hogs, 17,108; all kinds, 54,443. The sources of cattle supply were as follows:

Illinois	205,255	Virginia	2,758
Texas	39,652	Iowa	1,735
Kentucky	29,130	New Jersey	691
Ohio	24,888	Pennsylvania	591
New York	16,825	Kansas	586
Indiana	12,307	Connecticut	255
Missouri	11,268	Nebraska	129
Canada	4,960	Massachusetts	67
Michigan	4,929		

Western cattle, except Texas, bought in the Chicago market are credited to Illinois, and include large numbers raised in Iowa, Indiana, and Wisconsin.

The falling off in the number of hogs is attributed to the increased number of dressed hogs shipped in the winter from the West.

The following is a statement of prices at the end of the first market week in each month:

Month.	Beeves.			Sheep.	Hogs.
	Good to prime.	Common to fair.	Average.		
January	$0 16 to $0 18	$0 10 to $0 14	$0 15	$0 5 to $0 8	$0 10 to $0 10½
February	15 to 16½	10 to 13½	14¼	5 to 7½	9½ to 10
March	15½ to 16½	12 to 14½	14¾	5½ to 8	9 to 9¾
April	16 to 17	13 to 15½	15½	6½ to 9½	9¼ to 9¾
May	16¼ to 17½	13 to 15½	16	6½ to 7½	9½ to 10
June	16¾ to 18	13 to 16	16½	4¾ to 7½	9½ to 9⅞
July	15½ to 17	9 to 13	15¼	4 to 6½	9 to 9¾
August	15 to 16½	8 to 13	14½	4¼ to 6¼	9¼ to 9½
September	15 to 16½	7 to 13	14	4 to 6½	9½ to 10
October	15 to 16½	7 to 12½	13¼	4½ to 6	8⅞ to 9¼
November	14 to 16	7 to 12	13	4 to 6½	7½ to 7½
December	14½ to 16	9 to 13½	13	3¾ to 6	7 to 7¼

The receipts of beef and hog products for 1870, as compared with 1869, were:

	1870.	1869.
Beef, packages	127,298	82,191
Pork, barrels	123,296	94,552
Cut meats, packages	98,262	83,971
Lard, packages	93,523	75,527
Lard, kegs	24,989	15,9[illegible]

BALTIMORE.

The receipts of cattle in the Baltimore market for 1870 reach 89,021 head, against 91,000 in 1869; 75,891 in 1868, and 55,713 in 1867. Less than one-half were taken for local consumption, the larger portion having been purchased for shipment to other points. The receipts of live hogs for the year are estimated at 300,000. The number taken by packers and butchers has not been ascertained.

The prices of cattle on the 1st of each month, in 1870, were as follows:

Month.	Common.	Good.	Average.
January	4 to 5	7 to 8	6½
February	3¾ to 4½	6¾ to 8	6
March	4½ to 5	7¾ to 8¾	6½
April	4 to 5	7¾ to 9¼	6¾
May	5 to 6	8 to 9¼	6¼
June	5 to 5½	8½ to 9¾	7¼
July	4¼ to 6	7 to 8¼	7
August	4¼ to 6	7 to 8	6½
September	4¾ to 6¼	7½ to 7¾	6½
October	3½ to 6	6¼ to 7½	6
November	3½ to 5	5¾ to 7	6
December	3¼ to 4¾	5½ to 7	6

The following were the prices of live hogs on the 15th of each month during the same period:

January	12½ to 13½	July	12½ to 13
February	12 to 12	August	13 to 13½
March	11½ to 12¾	September	12¾ to 13½
April	12¾ to 13½	October	11½ to 12
May	12½ to 13¼	November	9½ to 10
June	12¼ to 13½	December	9 to 9½

SOUTHWESTERN VIRGINIA CATTLE TRADE.

The following facts relative to the cattle trade of Southwestern Virginia, of which Lynchburg is one of the principal points for reshipment to the North, especially to Baltimore, are derived from the *News* of the former place. The total value of the trade of 1869 was $1,028,000. In 1870 the shipments from Lynchburg, via the Orange, Alexandria and Manassas road, were—car loads of beef cattle, 485; stock cattle, 492; sheep, 91; hogs, 21. Total number of beef cattle, 9,700; stock cattle, 12,300, and sheep, 8,190. Value of beef cattle, $945,750; stock cattle, $498,150; sheep, $24,570; hogs, $26,460; total value, $1,494,930. Add to this about $250,000 worth of cattle driven to the Lynchburg market. The following summary is given:

Shipped by Orange road	$1,494,930
Driven direct to market	250,000
Sold to Lynchburg butchers	60,000
Shipped by South Side road	150,000
Total value	1,954,930

Increase over 1869, $926,930.

SAINT LOUIS.

The increase in the cattle trade of St. Louis over former years is very marked. It is claimed that when the railroads pointing toward the great cattle-producing regions of Texas, New Mexico, Arkansas, and the Indian reserves, are completed, they will make SaintLouis pre-eminent as a cattle-receiving point. With present transportation facilities the trade has almost doubled since 1869, the receipts in that year having been 134,576, against 240,864 in 1870. The following is a comparison of the receipts and exports of 1869 and 1870:

Year.	Cattle.	Hogs.	Sheep.
1869.			
Receipts	134, 576	342, 854	10, 849
Exports	50, 487	30, 828	12, 416
1870.			
Receipts	240, 864	228, 920	94, 477
Exports	129, 322	16, 476	96, 629

The falling off in the receipts of hogs, in 1870, was principally due to the fact that the packing season opened thirty days later than usual.

The following is the range of prices for convenience, those of the first week in each month being given:

Month.	Cattle, per pound.	Sheep, per head.	Hogs, per pound.
January	\$0 02⅜ to \$0 06¾	\$1 25 to \$3 37½	\$0 08 to \$0 09¼
February	03¼ to 06½	2 25 to 4 50	08 to 09
March	....	....	08 to 09½
April	....	....	....
May	04⅝ to 07 3-5	5 00 to 8 00	06 to 09¼
June	03½ to 08	5 00 to 8 00	06¾ to 09¼
July	02 to 07¼	3 35 to 4 75	06⅝ to 09
August	02¼ to 07¼	3 87 to 5 00	07⅛ to 09½
September	02½ to 07½	3 00 to 3 65	06⅜ to 10½
October	01¾ to 06	2 75 to 3 50	07½ to 09
November	02¼ to 06½	1 50 to 4 50	06 to 07¼
December	02 to 06¼	2 40 to 4 75	05¼ to 06⅜

The following is a comparison of the prices of hog products at the periods named, as prepared by the Saint Louis Journal of Commerce:

Date.	Hogs, (gross.)	Mess pork.	Dried salt shoulders.	Clear sides.	Lard in tierces.
1868.	*Cts. per lb.*	*Dolls. per bbl.*	*Cts. per lb.*	*Cts. per lb.*	*Cts. per lb.*
December 1	7 to 7¾	22 to 23	9¼ to 9½	13¼ to 13½	13½ to 14
December 31	7½ to 9¾	28 to —	11 to 11¾	14¾ to 15	16 to 17
1869.					
December 1	9¼ to 10½	30 to —	12¼ to 12½	16¼ to 16½	17 to 17¼
December 31	8½ to 8¾	28½ to 29	11¼ to 11½	15 to 15½	17 to 17½
1870.					
December 1	5¾ to 6½	19 to 19¼	7¼ to —	11 to —	12 to 12¼
December 31	6 to 6½	19 to 19¼	6¾ to —	10¼ to —	....

CHICAGO.

The largest proportion of cattle for this market was contributed by Texas. A large number also were sent forward from Kansas, Nebraska, Colorado, and Wyoming. Many of the latter, however, were of the Texas breed, fattened upon the plains of Kansas and the Territories.

The receipts of hogs were mainly from Illinois, Missouri, Wisconsin, and Iowa, the latter State furnishing the largest number. The total receipts of all descriptions of live stock were largely in excess of those of 1869. The increase is thus stated: Cattle, 129,862; hogs, 31,282; sheep, 9,783; horses, 2,013.

The following is a comparison of the receipts and exports of 1870 compared with those of 1869:

Year.	Cattle.	Hogs.	Sheep.
1869.			
Receipts	403, 102	1, 661, 869	340, 072
Exports	294, 717	1, 026, 305	108, 690
1870.			
Receipts	532, 964	1, 693, 158	349, 855
Exports	391, 709	924, 453	116, 711

Average monthly prices per 100 pounds for the year 1870.

Months.	Cattle.	Hogs.	Sheep.
January	\$3 74 to \$7 67½	\$8 50 to \$9 93	\$3 00 to 5 50
February	3 77 to 7 81½	8 52 to 9 40	3 00 to 5 25
March	4 10 to 7 68	8 21 to 8 96	4 50 to 7 37½
April	4 55 to 8 52	8 42 to 9 22	3 28 to 7 45
May	4 20 to 8 75	8 42 to 9 12	4 25 to 7 60
June	3 70 to 9 03	8 22 to 8 89	2 70 to 5 40
July	3 63 to 9 07	8 60 to 9 28	2 25 to 4 00
August	3 67 to 8 81	9 21⅜ to 9 92	2 40 to 4 25
September	3 34¾ to 7 65	8 45 to 9 06	2 50 to 4 00
October	3 14¼ to 7 34½	7 47 to 8 08	2 35 to 4 05
November	2 96 to 7 37½	6 15 to 7 24	2 70 to 4 00
December	2 85 to 7 30	5 88 to 6 28	2 75 to 4 27½

The average prices per 100 pounds for the year 1869 were: Cattle, \$3 79 to \$7 72; hogs, \$8 93⅙ to \$10 25½; sheep \$2 58⅙ to \$5 40⅙. The value of the live stock received during the year 1870 is estimated at \$67,000,000.

Since the opening of the Union Stock Yards, December, 1865, the receipts and exports have been as follows:

	Receipts.	Exports.
Cattle	1, 983, 398	1, 297, 686
Hogs	7, 738, 057	3, 592, 751
Sheep	1, 351, 110	432, 757

Showing an excess of receipts of 685,715 cattle, 4,145,306 hogs, and 918,353 sheep.

WOOL PRODUCTION AND CONSUMPTION.

The aggregate importation of woolens in each of the past five decades, ending in the years named, is as follows:

	1830.	1840.	1850.	1860.	1870.
Aggregate	\$86, 182, 110	\$129, 336, 258	\$109, 023, 552	\$282, 682, 830	\$320, 340, 346
Annual average	8, 618, 211	12, 933, 625	10, 902, 355	28, 268, 283	32, 034, 034

The following statement gives in detail the quantity and value of

wools and woolens imported in the past ten years, as well as the quantity and value of shoddy:

Years.	Woolens.	Wool.			Shoddy.		
		Pounds.	Value.	Cents per pound.	Pounds.	Value.	Cents per pound.
1861	$28,261,039	36,000,000	$4,961,326	13.7	....	....	....
1862	14,884,394	43,571,026	6,994,606	16	6,291,077	$442,376	7
1863	20,411,625	73,897,807	12,553,931	16.9	7,867,691	581,234	7.3
1864	32,139,336	90,396,104	15,923,991	17.6	8,133,391	621,514	7.6
1865	20,347,563	43,858,154	7,728,383	17.6	4,863,064	410,395	8.4
1866	57,115,901	67,917,031	9,381,083	13.8	7,147,108	589,490	8.2
1867	45,813,212	36,318,299	5,915,178	16	5,220,296	518,479	9.9
1868	32,371,329	24,124,803	3,792,659	15.7	556,414	49,649	8.9
1869	34,560,324	39,275,926	5,600,958	14.2	832,283	68,103	8.1
1870	34,435,623	49,230,199	6,743,350	13.6	512,792	55,009	10.7
Total	320,340,346	504,589,349	79,595,465	....	41,424,026	3,336,249	....
Average	32,034,034	50,458,934	7,959,546	15.7	4,142,402	333,624	8

The following is a statement of the importations of the fiscal year ending June 30, 1871:

	Quantity.		Value.	
	1871.	1870.	1871.	1870.
Wool ....lbs..	68,058,028	49,230,199	$9,780,443	$6,743,350
Shoddy ....lbs..	1,277,495	512,792	87,667	55,609
Cloths and cassimeres	....	....	10,902,761	7,671,013
Shawls	....	....	2,160,037	1,867,874
Blankets	....	....	28,050	21,952
Carpets	4,775,705	3,729,904	4,691,260	3,940,707
Dress goods	72,361,713	61,362,034	18,586,874	15,447,960
Hosiery, shirts, and drawers	....	....	538,770	441,598
Other manufactures	....	....	6,844,420	5,043,955
Total value	....	....	53,620,282	41,234,018
Value of wool and shoddy	....	....	9,868,110	6,798,959
Value of woolens	....	....	43,752,172	34,435,059

An increase both in quantity and value thus appears—18,827,829 pounds, and $3,037,093. The average price is advanced from 13.6 cents to 14.3 cents (gold) per pound. There is also an increase in the value of woolens imported of $9,317,113, or 27 per cent. The principal portion of this increase has been in cloths and carpets. It will be seen that the importation of wools equals that of 1865-'66, and is not exceeded by that of any year since 1863-'64.

PRODUCTION OF OTHER COUNTRIES.

The European production of wool, according to accepted estimates, is about equal to that of the other divisions of the globe. German estimates, quoted in the report on wools of the Paris Exposition Commission, make the production in Europe 827,000,000, of which Great Britain yields 260,000,000, Germany 200,000,000, France 123,000,000, European Russia 125,000,000, and Spain, Italy, and Portugal together 119,000,000; in Asia 470,000,000; in the entire world, 1,610,000,000. Since that date the production in Australia has increased. Great Britain presents the largest market for wool, and the increase in the supply is indicated by the increase in importation. In 1820 Great Britain imported less than 10,000,000 pounds; in ten years more her importation was 32,000,000; in 1840 it had increased to 49,000,000; to 74,000,000 in 1850; to 133,000,000 in 1859; and to 255,000,000 in 1869. Thus the increase of imported wools has been 122,000,000 in ten years in Great Britain, a quantity nearly equal to the present clip of the United States. Australia in 1840 contributed less than 10,000,000, but sent 39,000,000 in 1850, 53,000,000

in 1859, and 158,000,000 in 1869, an advance in ten years of 105,000,000, about 200 per cent. The receipts from South Africa, which were 14,000,000 in 1859, had become 34,000,000 in 1869. The receipts from Australia were 175,081,427 pounds in 1870, and the total importation for the same year was 259,361,963 pounds.

The following statement shows the sources of this supply and the quantity obtained from each country in the past three years:

	1868.	1869.	1870.
	Pounds.	*Pounds.*	*Pounds.*
From Europe	22, 267, 637	25, 199, 401	23, 686, 039
From South Africa	35, 993, 572	34, 307, 882	32, 785, 271
From India	17, 602, 442	18, 796, 578	11, 143, 148
From Australia	155, 745, 199	158, 477, 960	175, 081, 427
From other countries	19, 320, 604	18, 379, 522	16, 666, 078
Total	250, 928, 854	255, 161, 343	259, 361, 963

The number of sheep in the British Colonial Possessions in 1868, as officially reported, was 57,734,589, distributed as follows: New South Wales, 13,909,574; Victoria, 9,532,811; South Australia, 4,477,445; West Australia, 599,756; Queensland, 8,921,784; Tasmania, 1,742,914; New Zealand, 8,409,919; Mauritius, 18,057; Natal, 286,264; Cape of Good Hope, 9,836,065.

COTTON CONSUMPTION.

The manufacture of cotton in this country is slowly increasing. In October, 1870, according to the estimate of the National Association of Cotton Manufacturers, which was based upon actual returns from a large proportion of the mills, there were in operation 847 mills, running 7,114,000 spindles and consuming 831,564 bales of cotton of 466 pounds each, in the year closing at that date—an increase of 3 mills, 350,443 spindles, and 7,310 bales. Of these mills 738 were in the North, with 6,851,779 spindles, consuming 748,153 bales, and in the South 109 mills, running 262,221 spindles, and using 69,067 bales, the remainder being used in woolen mills for upholstering, &c. Thus 28 per cent. of the crop of 1869 was consumed in this country. In 1860 the consumption of the United States was about one-fifth of the crop.

In 1820 the proportion of cotton imports of Great Britain furnished by the United States was fifty-two per cent.; in 1830, seventy-two; in 1840, seventy-seven; in 1850, sixty-seven; in 1860, eighty; and in 1870, after reduction to a trifling percentage during the late war, it has reached fifty-four per cent., with a certainty that the importation of 1871, from the great crop of 1870, will nearly restore the old proportion.

A parliamentary report makes the following statement of the number of spindles in the United Kingdom in September, 1870, in comparison with the numbers reported at former dates:

	1856.	1861.	1870.
England and Wales	25, 819, 000	28, 352, 000	36, 023, 120
Scotland	2, 041, 000	1, 915, 000	1, 210, 847
Ireland	151, 000	120, 000	125, 326
Total in United Kingdom	28, 011, 000	30, 387, 000	37, 359, 293

At 35 pounds of cotton to the spindle, the amount annually consumed cannot, for several years, exceed 1,300,000,000 pounds, or less than three millions of American bales, and has actually been much less than that. With the present supply of India and other foreign cotton, the United States cannot expect to furnish much more than two millions of bales to

Great Britain for several years to come, and not more than three millions to all foreign countries together, so that a crop like that of 1870, with the supplies from other countries, will give a surplus of half a million bales until the spindles of the world shall have been materially increased.

The following statement shows the status of British importations for the years named:

	1850.	1860.	1870.
	Pounds.	*Pounds.*	*Pounds.*
United States	493, 153, 112	1, 115, 890, 608	716, 245, 040
Brazil	30, 299, 982	17, 286, 864	63, 691, 680
Mediterranean	18, 931, 414	44, 036, 6 8	153, 228, 320
British East Indies	118, 872, 742	204, 141, 163	341, 599, 776
British West Indies	228, 913	1, 050, 784	....
Other countries	2, 090, 698	8, 532, 720	61, 606, 832
Total	663, 576, 861	1, 390, 938, 752	1, 336, 371, 648

The increase of ten years, through earnest and persistent efforts of European cotton supply association, in India, Egypt, and Brazil, has been less than that made in the United States in the single year of 1870 over the previous crop. It is evident that no stimulation of production elsewhere will destroy our foreign market for cotton, and manifest, to the most superficial observer, that as the manufacture increases in this country, and the proportion for export diminishes, the more indispensable to foreign manufacturers will be that surplus. The quality of our cotton, its indubitable superiority to that of India, will make it a necessity to Europeans, who would compete with the manufactures of the United States in the markets of the world. It is evidently the destiny of this country to take a large share in the business of supplying the world with manufactured cotton, a result to which the quality of the staple and the inventive genius and skill of Americans will largely contribute. The quantity of cotton exported from this country in the last eleven years, (fiscal years ending June 30,) both upland and sea island, with the value of the same, is presented in the following statement:

Year.	UPLAND.		Price per pound.	SEA ISLAND.	
	Quantity.	Value.		Quantity.	Value.
	Pounds.		*Cents.*	*Pounds.*	
1861	301, 345, 778	$34, 051, 483*	10. 1	6, 170, 321	....
1862	4, 998, 121	1, 180, 113*	23. 8	66, 443	....
1863	10, 857, 239	6, 652, 405*	61. 2	527, 747	....
1864	11, 860, 390	9, 768, 071	82. 5	132, 521	$127, 783
1865	6, 276, 582	5, 424, 370	86. 6	330, 584	296. 179
1866	643, 288, 356	274, 960, 453	42. 5	7, 284, 473	6. 424. 770
1867	654, 731, 274	197, 115, 582	30. 1	6, 742, 314	4, 354. 841
1868	779, 765, 318	149, 797, 399	19. 2	4, 998, 315	3, 023. 334
1869	641, 542, 677	160, 258, 160	24. 9	2, 785, 244	2, 374. 892
1870	954, 148, 843	224, 121, 191	23. 4	6, 309, 780	2, 906. 433
1871	1, 459, 715, 036	216, 889, 570	14. 8	3, 212, 968	1, 437, 539

* Including sea island.

The largest returns for a single year's exportation ever made were those for the year ending June 30, 1866, a portion of the cotton having been produced in 1865, and the remainder brought forth from the hidden stores of previous years, all realizing an average of 42.5 cents per pound. The export of 1870, mainly the crop of 1869, yielded $224,121,191, at 23.4 cents per pound.

The export of the fiscal year ending June 30, 1871, amounted to 1,459,715,036 pounds, and realized $216,889,570. Thus the export of 3,132,650 bales (of 466 pounds) which furnished a surplus above the requirements of consumption, brought $7,231,621 *less* than 2,047,527 bales which were needed for current use by the mills of Europe.

MARKET PRICES OF FARM

Prices of certain products of 1870 *in some of the principal cities. The*

Products.	January.	February.	March.	April.	May.
NEW YORK.					
Flour, superfine, State	$4 87 to $5 00	$4 70 to $4 85	$4 75 to $4 90	$4 50 to $4 60	$4 80 to $4 95
western	4 75 to 5 00	4 60 to 4 85	4 75 to 4 85	4 50 to 4 55	4 80 to 4 90
extra, western	5 20 to 5 40	5 05 to 5 30	4 95 to 5 20	4 60 to 4 80	5 00 to 5 25
Wheat, spring	1 22 to 1 24½	1 18 to 1 23	1 03 to 1 22	1 03 to 1 12	1 15 to 1 23
winter, red and amber, western	1 33 to 1 35½	1 28 to 1 31	1 30 to 1 32	1 23 to 1 27	1 28 to 1 30
Corn, western, mixed	1 14	88 to 91	92 to 96	1 03 to 1 06	1 05 to 1 12
yellow	1 01 to 1 02	97	1 02	1 05 to 1 08	
Oats, western	62 to 63	55½	55 to 56½	55½ to 57½	62½ to 63½
Ohio and State	65 to 66	58 to 60	62 to 63½	61 to 62½	67 to 69
Hay, shipping qualities	17 00	17 00 to 18 00	19 00 to 20 00	18 00 to 19 00	18 00
prime	20 00 to 23 00	19 00 to 23 00	22 00 to 23 00	21 00 to 24 00	20 00 to 25 00
Pork, mess	29 00 to 29 50	26 50 to 27 00	25 62 to 26 00	26 00 to 26 75	28 50 to 29 00
prime mess	26 00 to 28 00	24 00 to 26 00	23 50 to 24 00	22 00 to 22 25	25 50
Beef, plain mess	5 00 to 13 00	10 00 to 15 00	10 00 to 15 00	10 00 to 15 00	12 00 to 15 00
extra mess	11 00 to 17 00	14 00 to 17 00	14 00 to 17 00	13 50 to 17 00	16 00 to 18 00
Lard, prime, tierce	16 to 18¾	15½ to 18	14 to 16	14 to 15¾	16 to 17¼
Butter, western	18 to 33	14 to 31	14 to 26	14 to 26	14 to 20
State, dairy	30 to 44	36 to 46	28 to 46	25 to 43	20 to 25
Cheese, dairy	16 to 17	16 to 17½	16 to 17½	13 to 14	15 to 16
factory	17 to 18	17 to 18	17 to 18	14 to 15½	16 to 17
Cotton, low middling	24⅞ to 25⅝	24¾ to 25½	22⅛ to 27⅜	21¾ to 22¼	22⅛ to 22⅞
middling to good middling	25⅞ to 26⅜	25¾ to 27	23¼ to 25¼	22¾ to 25¼	23⅛ to 25¼
Tobacco, sound lugs	8¼ to 9¾	8 to 9½	8 to 9½	7¾ to 8¾	7¾ to 8¼
common, leaf	9½ to 11	9½ to 10¾	9½ to 10¾	8¾ to 10	8½ to 9½
medium, leaf	10¼ to 11¾	10½ to 11½	10½ to 11¼	10 to 11	9½ to 10½
Wool, combing fleece				60	
extra pulled	42 to 48	41 to 46	40 to 42	44 to 47	40 to 43
Texas common, unwashed		21	33		28 to 30
CHICAGO.					
Flour, white winter extra choice	7 50 to 8 00	6 00	6 35	6 25	6 50
red winter, extra	5 00 to 6 00			4 75	
spring extra, good to choice	4 25 to 5 50	3 65 to 4 75	3 70 to 4 75	3 50 to 4 75	4 37½ to 5 00
superfine	3 15 to 3 50	3 40 to 3 50	3 50 to 3 62½	3 30	3 70
Wheat, No. 1 spring	83	89	85½ to 86	87	95 to 99
No. 2 spring	76¾ to 77¼	79½ to 80	78¾ to 79¾	75¾ to 78	87¾ to 89
No. 3 spring	68½ to 69	73½ to 74	71¾ to 72	72½ to 72¾	80½ to 82
Corn, No. 2	69 to 72	70 to 72	69½ to 70	76 to 77½	86 to 87
rejected		70			82½ to 83
Oats, No. 2	40 to 43½	38 to 38¼	37½ to 37⅝	38¼ to 42	45¾ to 47½
rejected	33½ to 34	33½	32 to 33¼		45
Hay, timothy, pressed, (on track)	12 00 to 13 00	11 00 to 12 00	11 00 to 12 00	12 00 to 13 00	13 00 to 14 00
prairie, pressed, (on track)	9 00 to 10 00	8 00 to 9 00	8 00 to 9 00	9 50 to 11 00	10 50 to 11 50
Pork, mess	27 50 to 27 75	26 00 to 26 75	25 25 to 26 00	25 75 to 26 50	27 75 to 28 50
Lard	16 to 16¼	14¾ to 15¾	14 to 14⅜	14¼ to 14½	15½
Butter, choice	30 to 33	28 to 30	28 to 30	31 to 34	25 to 27
fair to good		22 to 25	22 to 25	25 to 28	22 to 24
Wool, unwashed, fine	24 to 26	26 to 27	26 to 28	28 to 30	28 to 30
unwashed, coarse	26 to 28	28 to 29½	28 to 30	30 to 32	30 to 32
tub	45 to 53	45 to 50	47 to 53	47 to 53	47 to 55
CINCINNATI.					
Flour, family	5 25 to 5 75	5 25 to 5 75	5 00 to 5 50	5 10 to 5 50	5 00 to 5 75
extra	4 85 to 5 00	4 85 to 5 00	4 50 to 4 75	4 75 to 5 00	4 75 to 4 90
superfine	4 25 to 4 50	4 80	4 00 to 4 25	4 40 to 4 60	4 40 to 4 50
Wheat, No. 1 white		1 25			
No. 2 white		1 20			
No. 1 red	1 12	1 12	1 08	1 10 to 1 11	1 10 to 1 11
No. 2 red	1 08	1 10	1 05 to 1 06	1 05	1 06 to 1 07
Corn, No. 1					
No. 2					
Oats, No. 1	54 to 55	53 to 54	52	54 to 55	58 to 59
No. 2	52 to 53	50 to 52	49 to 50	52 to 53	56 to 57
Hay, common	10 00 to 12 00	12 00 to 14 00	12 00 to 13 00	13 00 to 14 00	12 00 to 13 00
loose pressed	17 00 to 23 00	17 00 to 23 00	16 00 to 22 00	19 00 to 20 00	17 00 to 22 00
Pork, mess	27 50	25 25 to 26 50	26 00 to 27 00	26 50 to 27 00	28 50 to 29 25
Lard	15¾ to 19	15 to 19	14 to 17½	14½ to 18	16½ to 19½
Butter, choice Ohio	31 to 33	28 to 30	30 to 32	34 to 35	27 to 30

PRODUCTS FOR 1870.

quotations are given, as nearly as practicable, at the first of each month.

June.	July.	August.	September.	October.	November.	December.
$4 75 to $4 85	$5 10 to $5 30	$5 30 to $5 95	$5 10 to $5 45	$4 85 to $5 00	$5 30 to $5 50	$5 00 to $5 20
4 75 to 4 85	5 10 to 5 30	5 30 to 5 95	5 10 to 5 40	4 85 to 5 00	5 30 to 5 50	5 00 to 5 20
5 00 to 5 15	5 40 to 5 70	6 15 to 6 25	5 45 to 5 65	5 20 to 5 85	5 75 to 6 30	5 75 to 6 30
1 18 to 1 28	1 06 to 1 30	1 05 to 1 24	1 11 to 1 25	1 05 to 1 30	1 14 to 1 32½	1 18 to 1 37½
1 30 to 1 34	1 43 to 1 45	1 52 to 1 55	1 38 to 1 44	1 27 to 1 32	1 34 to 1 35	1 43 to 1 46
1 05 to 1 09½	97 to 1 05	95 to 1 00	84 to 85½	85 to 87	80 to 82	76 to 86
1 08 to 1 11	1 00 to 1 05	1 08 to 1 09	90 ...	...	84 ...	...
60 to 61	60 to 63	55 to 56	50 to 52	51 to 63	53 to 54	62 to 63
66 to 68	67½ to 69	64 to 66	51 to 57	...	55 to 59	63 to 64
16 00 ...	15 00 ...	17 00 to 18 00	17 00 to 18 00	20 ...	...	21 00 ...
18 00 to 22 00	18 00 to 23 00	...	18 00 to 25 00	...	24 00 to 29 00	23 00 to 26 00
29 62 to 29 87	29 00 to 29 25	30 25 to 30 50	27 87 to 28 25	24 62 to 24 75	24 00 to 25 50	22 00 to 23 00
26 00 to 26 50	25 75 to 26 00	... 31 00	30 00 to 31 00	21 50 to 23 50	21 00 to 22 50	22 00 to 23 00
11 00 to 15 00	11 00 to 15 00	12 00 to 16 00	12 00 to 16 00	12 00 to 15 50	10 00 to 15 00	10 00 to 15 00
16 00 to 18 00	16 00 to 18 50	16 00 to 19 00	16 00 to 19 00	16 00 to 18 50	15 00 to 18 00	15 00 to 18 00
14¾ to 16½	14½ to 16¾	16 to 17¾	16 to 17⅞	14¼ to 16¼	14 to 16¼	13 to 13½
10 to 25	16 to 28	20 to 28	20 to 28	20 to 30	20 to 32	14 to 30
20 to 30	24 to 32	24 to 33	24 to 38	24 to 42	24 to 45	20 to 47
8 to 15½	8 to 14	8 to 14	5 to 13	5 to 13	7 to 14	7 to 14
10 to 15⅝	10 to 14¼	10 to 14½	5 to 14	5 to 15	10 to 15¾	13 to 16¼
21¾ to 22½	19½ to 20¼	19 to 19½	18⅞ to 19⅜	16 ...	16⅜ to 17⅛	15½ to 16⅛
22⅛ to 24⅝	20½ to 23¾	20 to 20½	19⅞ to 20⅜	16½ ...	16¾ to 18	15⅞ to 17⅛
8¾ to 9½	7½ to 10	9 to 10	8 to 8¾	7½ to 8	7 to 8¾	7 to 8¾
8¾ to 9¼	8¼ to 10¾	10¼ to 10¾	9 to 9¾	8¼ to 9	7¾ to 9¾	7¾ to 9¾
9½ to 10½	9¼ to 11¾	11 to 11¾	10 to 10¾	9¼ to 9¾	8¾ to 10¾	8¾ to 10¾
...	...	55 to 60	55 to 60	55 to 60	...	...
39 ...	39 ...	37 to 42	37 to 42	37 to 42	41 to 42½	40 to 43
22½ to 29	26 to 30	18 to 21	23 to 26	23 to 26	22 to 25½	27 to 34
7 75	5 75 to 7 59	7 00 to 8 25	6 50 to 8 25	5 25 to 7 50	7 00 to 7 50	5 75 to 7 25
...	5 50 to 6 50	6 00 to 6 75	6 00 to 6 75	4 75 to 5 50	4 75 to 6 00	...
5 00 to 5 50	4 87½ to 6 25	6 00 to 6 50	5 50 to 6 25	5 00 to 5 50	5 00 to 5 50	5 25 to 5 50
3 75 to 3 85	4 75 to 6 00	4 75 to 5 00	4 25 to 4 50	3 25 to 3 75	4 00 to 4 50	4 00 to 4 25
1 01½ to 1 03	1 14 ...	1 30 to 1 32	1 10 to 1 10½	1 05 to 1 05½	1 00 to 1 07½	1 02½ to 1 03½
97 to 99	1 04½ to 1 09¼	1 23 to 1 30	99½ to 1 09½	1 04 to 1 05¼	97 to 1 05½	1 01 to 1 02½
85 to 86	95 to 96	1 10 to 1 12½	90 to 1 03	82 to 96	91 to 1 01	91 to 97½
81¼ to 84	79 to 84	83¼ to 85½	64¾ to 66	63 to 63½	52 to 56	53 to 61½
74 to 76	72¾ to 73	76½ to 78	62 to 62¾	59½ to 60¼	48 to 53	42 ...
47½ to 48½	43 to 52½	43 to 45	37¼ to 38	36¼ to 37	35½ to 35¾	38 to 38½
39¾ to 40¼	43 to 44	39 to 40	34½ to 35¼	34 to 35	34 to 34½	34½ ...
12 00 to 13 00	13 50 to 15 00	14 00 to 15 50	15 00 to 16 00	15 00 to 16 00	16 00 to 17 00	15 00 to 16 00
9 00 to 10 00	10 00 to 11 00	11 00 to 14 00	10 00 to 13 00	10 50 to 11 50	11 00 to 12 00	10 50 to 11 00
28 00 to 29 50	28 00 to 29 50	25 00 to 26 00	23 00 to 25 00	25 00 ...	22 00 to 24 50	18 50 to 19 25
15¼ to 15¾	15½ to 15¾	14½ to 16¼	14½ to 16	14 to 15	14¾ ...	11¼ to 12
21 to 23	22 to 24	23 to 25	24 to 26	24 to 26	28 to 30	27 to 30
18 to 20	18 to 20	18 to 20	18 to 20	16 to 18	20 to 25	21 to 24
25 to 27	24 to 26	24 to 28	24 to 28	24 to 28	25 to 26	25 to 26
26 to 28	25 to 27	27 to 30	27 to 30	29 to 30	26 to 27	28 to 30
44 to 55	45 to 53	45 to 50	45 to 50	45 to 50	42 to 48	45 to 50
5 25 to 5 50	5 50 to 5 75	6 60 to 7 00	5 50 to 5 75	5 75 to 6 00	5 75 to 6 00	5 50 to 5 75
4 90 to 5 10	5 25 to 5 40	6 35 to 6 60	5 25 to 5 50	5 50 to 5 75	5 40 to 5 60	5 25 to 5 50
4 60 to 4 70	4 75 to 5 00	5 75 to 6 00	4 50 to 4 75	4 75 to 5 00	4 75 to 5 00	4 25 to 4 50
...	1 40 ...	1 50 to 1 55	1 25 ...	1 30 to 1 35	1 15 to 1 25	1 20 to 1 33
...	1 38 ...	1 40 to 1 45	1 20 to 1 25	...	...	...
1 14 ...	1 15 to 1 16	1 33 to 1 35	1 15 to 1 16	1 18 ...	1 12 ...	1 17 to 1 19
1 12 ...	1 12 to 1 13	1 28 to 1 30	1 12 ...	1 15 ...	1 10 ...	1 16 ...
90 to 91	83 to 85	90 ...	79 to 80	...	...	50 to 52
...	...	...	...	66 to 67	60 ...	...
57 to 58	58 ...	50 to 55	...	43 to 45	39 to 40	42 to 44
54 to 55	55 to 56	45 ...	...	40 to 43	37 to 39	37 to 39
12 00 to 13 00	12 00 to 13 00	14 00 to 15 00	12 00 to 14 00	12 00 to 14 00	12 00 to 14 00	12 00 to 14 00
16 00 to 22 00	16 00 to 20 00	19 00 to 24 00	17 00 to 21 00	20 00 to 21 00	17 00 to 22 00	20 00 to 24 00
29 00 to 29 75	29 75 to 30 00	30 00 to 30 50	27 50 to 28 00	24 50 to 24 75	24 50 to 25 00	19 00 to 19 25
15¾ to 19½	15¾ to 19¼	16 to 20½	15 to 19½	14½ to 18¼	15½ to 18½	12 to 16¼
20 to 22	20 to 22	25 to 27	28 to 30	31 to 33	33 to 35	28 to 30

MARKET PRICES OF FARM

Prices of certain products of 1870 *in some of the principal cities. The*

Products.	January.	February.	March.	April.	May.
CINCINNATI—Cont'd.					
Butter, fair to good	$0 25 to $0 30	$0 25 to $0 27	$0 25 to $0 27	$0 27 to [illegible]	$0 20 to $0 22
Cheese, choice factory	18 to 18¼	18 to 18½	17 to 18	16½ to 17	15¼ to 16
western reserve	17 to 17½	16¼ to 17½	16 to 16½	15 to 15½	14 to 15
Cotton, low middling	23½ to 23¾	23½ to 23¾	21	21	20¾ ....
middling	24 to 24½	24¼ to 24½	22	22	21¾ ....
Tobacco, common lugs, W. Virginia	10 to 12	10 to 12	10 to 11	4½ to 6½	4½ to 6½
fillers, Ohio	10 to 14	10 to 14	10 to 14	4¾ to 5	4¾ to 5
common lugs, Kentucky	11 to 12½	11½ to 12½	11½ to 11¾	6½ to 7	7 to 9
Wool, tub-washed	45 to 50	45 to 50	50 to 52	50 to 52	50 to 52
fleece-washed, manufacturing	40 to 43	42 to 43	45 to 48	45 to 48	45 to 48
fleece-washed, combing	45 to 50	45 to 50	45 to 50	45 to 50	45 to 50
unwashed, manufacturing	28 to 31	28 to 30	31 to 32	31 to 32	31 to 32
unwashed, combing	35 to 40	....	....	....	....
ST. LOUIS.					
Flour, spring	4 00 to 4 25	3 75 to 4 25	4 10 to 4 20	3 40 to 3 70	3 50 to 3 60
winter	4 00 to 4 30	4 15 to 4 90	4 15 to 4 75	3 90 to 4 50	4 00 to 4 50
family	6 75 to 5 50	7 00 to 7 50	7 00 to 7 75	7 00 to 7 75	7 50 to 8 50
Wheat, choice red	1 25 to 1 35	1 15 to 1 30	1 16 to 1 27	1 17 to 1 25	1 25 to 1 50
choice white	1 25 to 1 45	1 20 to 1 40	1 18 to 1 27	1 20 to 1 45	1 30 to 1 60
spring, No. 1	95 to 98	90 to 98	85 to 93	85 to 90	99 to 1 02
Oats, mixed, in sacks	51 to 53	52 to 54	4[illegible] to 51	52 to 53	[illegible] to 60
Corn, white, in sacks	80 to 85	79 to 87	77 to 85	83 to 87	1 00 to 1 05
yellow, in sacks	....	75 to 77	76 to 78	83 to 84	1 00 to 1 04
mixed, in sacks	75 to 83	74 to 77	76 to 77	82 to 83	1 00 to 1 02
Hay, choice	17 50	19 00	17 50	18 50	18 50 ....
prime	16 00 to 16 50	15 00 to 17 00	16 00 to 17 00	16 00 to 17 50	17 50 ....
Cotton, middling	23	22	21 to 21½	21 to 21¼	20½ to 27
Wool, tub-washed	40 to 50	40 to 50	50 to 53	48 to 51	45 to 53
fleece-washed	35 to 40	35 to 40	33 to 40	33 to 40	30 to 40
unwashed	30 to 34	30 to 34	26 to 33	25 to 30	24 to 37
Pork, mess	28 50	27 00 to 27 50	27 00	27 00 to 27 25	[illegible] 75 to 29 25
Lard	16 to 17	16 to 17	....	16	16½ to 18
Tobacco, factory lugs, average per month	5 65	4 90	5 75	5 80	7 25 ....
common leaf, average per month	8 00	7 75	8 25	8 10	[illegible] ....
medium leaf, average per month	9 00	8 80	9 00	9 10	[illegible] ....
Butter, choice	....	....	....	....	....
medium	....	....	....	....	....
Cheese, factory	....	....	....	....	....
NEW ORLEANS.					
Cotton, ordinary	21¼ to 22¼	21¼ to 22¼	19½ to 20	17¼ to 18¼	17[illegible] to 18½
middling	24¼ to 24½	24¼ to 24½	22½ to [illegible]	21[illegible] to [illegible]	22¼ ....
Pork, mess	30 00	29 50 to 30 00	29 00 to 29 25	28 25 to 28 50	30 00 to 30 50
Flour, superfine	5 30 to 5 50	5 70 to 5 75	4 25	4 12½ to 4 20	4 40 to 4 55
higher grades	5 75 to 8 50	6 05 to 8 50	5 00 to 8 50	4 65 to 8 20	5 00 to [illegible] 20
Corn, white	1 10½	1 20	95 to 1 00	1 15	1 45 to 1 50
yellow	1 10	1 20	1 05	1 15	1 40 ....
mixed	1 05 to 1 07½	....	....	1 10	1 35 ....
Oats	61 to 72	73 to 75	68 to 70	61 to 62	63 to 65
Hay, prime	26 00 to 34 00	28 00 to 35 00	28 00 to 37 00	26 00 to 28 00	24 00 to 26 50
choice	27 50 to 35 00	30 00 to 36 00	29 00 to 38 00	27 00 to 29 00	25 00 to 27 00
Lard, tierce, (extremes for month)	16½ to 18¼	16 to 16½	14 to 16	15 to 17	16 to 17½
Lard, keg, (extremes for month)	17¾ to 20	18 to 18½	17 to 18¾	18¾ to 19¼	18¼ to 19¼
Butter, western, (range for month)	17 to 22	15 to 22	15 to 28	15 to 28	12 to 30
northern, (range for month)	16 to 34	15 to 32	30 to 41	30 to 43	25 to 45
Cheese, (range for month)	17½ to 23	15½ to 22	15 to 21	15 to 22	12 to 23
Tobacco, common to good lugs	....	....	....	7 to 8	7 to 9
medium leaf	....	....	....	9½ to 11	9½ to 11

PRODUCTS FOR 1870.

quotations are given, as nearly as practicable, at the first of each month.

June.	July.	August.	September.	October.	November.	December.
$0 15 to $0 18	$0 15 to $0 16	$0 20 to $0 22	$0 22 to $0 25	$0 25 to $0 30	$0 25 to $0 33	$0 20 to $0 24
....	....	13½ to 14	13½ to 14	13 to 15	14½ to 15½	15 to 15½
12 to 13	9 to 10	....	10 to 12½	11 to 13½	13½ to 14	14 to 14½
20¼ to 20½	18¼	17½ to 17¾	17¾ to 18	14½	15 to 15½	14¾ ....
21¼ to 21½	19¼	18½ to 18¾	18¾ to 19	15½	15½ to 15¾	15¼ ....
4½ to 6½	4½ to 6½	4½ to 6½	4½ to 6½	4½ to 6½	4½ to 6½	4½ to 6½
5½ to 6	6 to 7½	5½ to 6¼	5½ to 6¼	5½ to 6¼	5½ to 6¼	6 to 7½
7¾ to 8¾	7¾ to 9	8 to 9½	7½ to 9½	7¼ to 9½	7 to 9½	7 to 9½
40 to 42	40 to 42	43 to 47	44 to 47	45 to 48	45 to 48	45 to 48
35 to 36	35 to 36	39 to 42	40 to 43	40 to 43	40 to 43	40 to 43
40 to 45	40 to 43	42 to 45	42 to 45	42 to 45	42 to 45	42 to 45
27	27	27 to 31	30 to 31	30 to 31	30 to 31	30 to 31
33 to 35	31 to 33	32 to 34	32 to 35	32 to 35	32 to 35	31 to 32
3 75 to 4 15	4 25 to 4 60	4 25 to 5 00	4 00 to 5 00	3 60 to 4 25	4 00 to 4 25	4 25 to 4 75
3 90 to 4 50	4 25 to 4 90	4 60 to 5 35	4 25 to 5 15	3 90 to 4 65	4 00 to 4 70	4 00 to 4 60
7 75 to 8 50	7 50 to 8 50	7 50 to 8 25	7 75 to 8 75	7 00 to 8 00	6 50 to 8 50	6 50 to 8 50
1 20 to 1 45	1 30 to 1 50	1 30 to 1 40	1 25 to 1 37	1 30 to 1 40	1 30 to 1 40	1 35 to 1 45
1 30 to 1 50	1 30 to 1 60	1 40 to 1 55	1 35 to 1 50	1 40 to 1 50	1 40 to 1 60	1 55 to 1 60
....	1 18	....	1 00	1 02 to 1 07	1 00 to 1 10	1 06 to 1 10
56 to 57	52 to 54	40 to 42	38 to 41	42 to 43	41 to 43	43 to 43½
1 03 to 1 10	88 to 97	90 to 94	72	64 to 69	70 to 71	55 to 61
94 to 98	78 to 85	80 to 83	67	68 to 69	....	54 to 59
90 to 97	75 to 83	72 to 80	67	....	60	52 to 54
17 00 to 17 50	16 50 to 17 00	18 00	17 50 to 18 50	17 50 to 18 00	19 00 to 20 00	20 50 to 21 00
14 50 to 16 50	13 50 to 15 50	16 00 to 17 00	16 00 to 17 00	15 50 to 16 00	17 50 to 18 00	17 50 to 18 00
19 to 20	18 to 19	18 to 19	17½ to 18	15 to 16	14½ to 15	13 to 14
35 to 46	35 to 46	35 to 45	36 to 46	40 to 47	40 to 48	40 to 48
33 to 42	33 to 42	33 to 40	34 to 41	35 to 41	35 to 41	35 to 41
20 to 32	20 to 32	22 to 33	19 to 32	20 to 31	20 to 31	20 to 31
30 00	30 00 to 30 25	31 00	28 00 to 28 50	24 50 to 25 00	25 50 to 26 00	19 00 to 19 50
16 to 17½	16 to 17½	16½ to 18	16 to 17½	15 to 17½	16 to 17½	12 to 14½
7 00	7 10	6 25	5 70	5 50	5 20	5 10 ....
8 65	8 75	8 40	8 00	7 90	7 50	7 50 ....
9 15	9 25	9 10	9 00	9 25	9 25	9 10 ....
....	....	26 to 29	25 to 28	29 to 31	33 to 35	32 to 34
....	....	22 to 25	18 to 20	....	18 to 22	25 to 28
....	....	14 to 15	....	14½ to 16	15½ to 16½	15 to 16½
17 to 18½	14½ to 15½	11½ to 12½	11½ to 12¼	11 to 11¾	12 to 13	12½ to 13½
21¾ to 22	19	17½ to 17¾	17¾	15 to 15½	15¼ to 15⅞	15 to 15½
31 50	31 50 to 32 00	32 00 to 32 50	30 00	25 75 to 26 00	26 75 to 27 00	22 75 to 24 00
5 50 to 5 62½	4 87½ to 5 00	5 40 to 5 50	5 25 to 5 35	4 25	5 00 to 5 12½	4 30 to 5 00
5 75 to 8 50	5 00 to 8 50	6 00 to 7 75	5 85 to 8 75	4 40 to 8 00	5 70 to 8 25	5 35 to 8 25
1 00 to 1 10	1 20 to 1 25	95 to 1 00	90	75	87½	70 to 75
1 00	1 10	90	90	75	90	80 ....
95	1 15	80 to 85	80	72½	85	....
68 to 70	68 to 72½	68 to 70	48 to 54	50 to 52	50 to 53	52 to 54
22 50 to 25 00	22 00 to 25 00	23 50 to 26 00	28 00	25 00 to 25 50	27 00 to 28 00	28 00 ....
24 00 to 27 00	23 00 to 26 00	25 00 to 23 00	30 00	24 50 to 25 50	29 00	31 00 ....
15¼ to 17½	15¾ to 17½	17½ to 18	17½ to 18½	16¼ to 16½	17 to 17½	13½ to 14
18¼ to 19½	18¾ to 19½	18½ to 19	19 to 20	19 to 20	17 to 19½	14 ....
22 to 38	26 to 28	24 to 36	25 to 32	30 to 35	30 to 35	30 to 33
30 to 37	30 to 36	30 to 37	25 to 43	49 to 45	40 to 45	40 to 45
10 to 20	10 to 16	9 to 16	13½ to 17	15 to 15½	15 to 16	14½ to 16½
....	7 to 9½	7½ to 9½	7½ to 8¼	6½ to 8½	6½ to 8	5½ to 8
....	9½ to 11	10 to 11	10 to 10½	9 to 10½	8 to 10½	7½ to 10

IMMIGRATION.

The immigration for the year 1870, as appears by the official record, amounted to 356,303, the aggregate of the foreign passenger list being 378,796, of whom 22,493 did not intend to remain in this country. The largest number of passengers from any one country was 91,779 from Germany. Ireland sent 75,544, England 59,488, Canada 51,278, Norway 12,356, Sweden 12,009, China 11,943, Scotland 11,820. The number from China is 3,797 less than in 1869. Japan sent 48 in 1869 and 74 in 1870.

The occupations of more than half of these immigrants is not stated; 1,854 males and 278 females are credited with professional callings, 180 males and 20 females are artists, and 31,372 males and 592 females skilled artisans; the "miscellaneous occupations" number 136,058 males and 9,724 females; 16,529 have no occupations; and from those whose occupation is not stated, 128,254 are women, leaving but 62,342 males unclassified.

A statement of the total immigration, from the earliest records of our national history, as prepared by the Bureau of Statistics of the Treasury Department, makes the grand aggregate 7,803,865. The decade ending in 1860 had the largest immigration, that ending in 1870 an influx almost equally large, and the entire immigration prior to 1850 was only a little larger than of either of the two subsequent decades. Great Britain sent her largest contributions in the decennial period ending in 1860, and nearly as many in the decade ending in 1850 as in that just closed. Among the countries increasing their offerings are British America, from which immigration has advanced from 59,309 to 167,349; Denmark, from 3,749 to 17,885; Belgium, 4,738 to 7,416; Italy, 7,012 to 12,796; China, from 41,397 to 68,059. It will be seen that nearly all our immigration is from Northern Europe, very little coming from Asia, and a scarcely appreciable amount coming from Africa or South America. The influx during the past two years has not been equal in volume, the "net emigration" of the first two years failing to reach ninety thousand per year, nearly doubling that figure in 1863, still increasing from that date to 1866, when it was 314,840, then falling the next year to 293,601, and in 1868 to 289,145, rising again in 1869 to 385,287, (the highest figure reached,) and in 1870 standing at 356,303.

The census of 1870 returns 5,566,546 persons foreign-born in a total population of 38,555,983; and 9,734,845 persons having both father and mother foreign, and 10,892,015 having a foreign father. Thus nearly 15 per cent. of our present population are actual immigrants, and 25 per cent. are of unmixed foreign parentage. These persons are mainly workers, increasing production and wealth very rapidly, developing resources that must long remain hidden without their aid, and especially serviceable in the primitive and ruder forms of labor by which railroads are built, factories manned, mines worked, and farm products grown.

The States increasing in wealth most rapidly are those which have secured the largest aid from this source. A day may come when increase of population may cease to add to the wealth of a State; but that time is far distant to any one of the United States. In New York more than one-third are foreign-born, more than half of foreign parentage; in Massachusetts, one-fourth are of foreign birth, and nearly one-half of foreign parentage; in Illinois and Iowa one-fifth were born in foreign lands; in Wisconsin and Minnesota more than one-third are foreign-born, and two-thirds of foreign parentage; and in Iowa and Kansas one-eighth are of foreign birth. All of the growing States, in which production and improvement are peculiarly noticeable, owe much of their growth and prosperity to the settlement and labor of immigrants. The pro-

gressive people of the South see the advantage of this stream of immigration and are devising means to divert a portion of it to their section. Hitherto it has been benefited by it only in a slight degree. The eleven States south and west of the Potomac, or the cotton States, have only 210,684 persons of foreign birth in a population of 9,487,386, or 23 per cent.; excluding Louisiana and Texas, but one per cent.

A statement, by occupations, of the number of passengers arrived in the United States for the fifty-one years ended December 31, 1870.

Occupation.	Prior to 1820.	1820-'30.	1831-'40.	1841-'50.	1851-'60.	1861-'70.	Aggregate.
Laborers	....	10,280	53,169	281,229	527,639	526,199	1,398,516
Farmers	....	15,005	88,240	256,880	404,712	211,742	976,579
Mechanics, not specified	....	6,805	56,582	164,411	179,726	163,994	571,518
Merchants	....	19,434	41,881	46,388	124,149	94,200	326,052
Servants	....	1,327	2,571	24,538	21,058	91,204	140,698
Miners	....	341	368	1,735	37,523	52,214	92,181
Mariners	....	4,995	8,004	6,398	10,087	18,788	48,272
Clerks	....	8,882	1,143	1,065	792	16,128	20,010
Weavers and spinners	....	2,937	6,600	1,303	717	3,233	14,790
Physicians	....	805	1,959	2,116	2,229	3,244	10,353
Seamstresses, dressmakers, and milliners.	....	413	1,672	2,096	1,065	3,405	8,651
Clergymen	....	415	932	1,559	1,420	3,117	7,443
Bakers	....	583	569	28	92	6,766	8,038
Artists	....	139	513	1,223	615	3,669	6,159
Butchers	....	329	432	76	108	5,651	6,596
Tailors	....	983	2,252	65	334	4,786	8,420
Shoemakers	....	1,109	1,196	63	336	4,563	8,037
Manufacturers	....	1,175	107	1,833	1,005	1,400	4,520
Lawyers	....	244	461	831	1,140	1,545	4,221
Masons	....	793	1,435	24	58	4,682	6,992
Engineers	....	226	311	654	825	1,738	3,754
Teachers	....	275	267	832	154	2,109	3,637
Millers	....	199	189	33	210	648	1,279
Painters	....	232	369	8	38	1,484	2,131
Printers	....	179	472	14	40	512	1,217
Musicians	....	140	165	236	188	612	1,341
Actors	....	183	87	233	85	268	856
Hatters	....	137	114	1	4	102	358
Other occupations	....	5,466	4,004	2,892	13,844	7,972	34,178
Occupations not stated, and without occupation.	*250,000	101,442	363,252	969,411	1,544,494	1,572,938	4,801,537
Total	250,000	176,473	640,086	1,768,175	2,874,687	2,808,913	8,518,334
Deduct citizens of the United States	....	24,640	40,961	54,924	276,473	317,462	714,469
Aliens	250,000	151,824	599,125	1,713,251	2,598,214	2,491,451	7,803,865

* Estimated.

A statement, by countries, of the number of alien passengers arrived in the United States from foreign countries, from the commencement of the Government to December 31, 1870.

Countries.	Prior to 1820.	1820 to 1830.	1831 to 1840.	1841 to 1850.	1851 to 1860.	1861 to 1870.	Aggregate.
England	....	15,837	7,611	32,092	247,125	213,527	516,192
Ireland *	....	57,278	198,233	733,434	936,665	774,883	2,700,493
Scotland	....	3,180	2,667	3,712	38,331	36,733	84,623
Wales	....	170	185	1,261	6,319	4,500	12,435
Great Britain, not specified	....	5,362	74,495	277,264	109,653	77,333	544,107
Total from British Isles	....	81,827	283,191	1,047,763	1,338,093	1,106,976	3,857,850
Germany	....	7,583	148,204	422,477	907,780	781,456	2,267,500
Prussia	....	146	4,250	12,149	43,887	40,551	100,983
Austria	....	....	....	....	....	9,398	9,398
Sweden and Norway	....	94	1,201	13,903	20,931	117,799	153,928
Denmark	....	189	1,063	539	3,749	17,885	23,425
Holland	....	1,127	1,412	8,251	10,789	9,539	31,118
France	....	8,868	45,575	77,262	76,358	37,749	245,812
Switzerland	....	3,257	4,821	4,644	25,011	23,839	61,572
Belgium	....	28	22	5,074	4,738	7,416	17,278
Spain	....	2,616	2,125	2,209	9,298	6,966	23,214
Portugal	....	180	829	550	1,055	2,031	4,695

A statement, by countries, of the number of alien passengers, &c.—Continued.

Countries.	Prior to 1820.	1820 to 1830.	1831 to 1840.	1841 to 1850.	1851 to 1860.	1861 to 1870.	Aggregate.
Italy		389	2,211	1,590	7,012	12,796	23,993
Sardinia		32	7	201	1,790	73	2,103
Sicily		17	35	79	429	115	675
Malta		1	35	78	5	8	127
Greece		20	49	16	31	82	198
Russia		89	277	551	457	2,671	4,045
Poland		21	369	105	1,164	2,379	4,038
Hungary						488	488
Turkey		21	7	59	83	137	307
China		3	8	35	41,397	68,059	109,502
Japan						259	259
India		9	39	36	43	81	208
Arabia						34	34
Syria						4	4
Persia				7		7	14
Asia, not specified		3	1	4	15	4	27
Cape of Good Hope		2				86	88
Liberia		1	8	5	19	31	64
Egypt			4		5	11	20
Abyssinia						5	5
Africa, not specified		10	36	47	186	191	470
British America		2,486	13,624	41,723	59,309	167,349	284,491
Mexico		4,818	6,599	3,271	3,078	2,386	20,152
Central America		107	44	368	449	96	1,064
Guiana						55	55
Venezuela						47	47
Peru						41	41
Chili						30	30
Buenos Ayres						10	10
Bolivia						3	3
New Granada						10	10
Brazil						54	54
Paraguay						1	1
South America, not specified		542	856	3,579	1,224	1,192	7,393
Cuba						4,240	4,240
Jamaica						100	100
Hayti						98	98
Porto Rico						57	57
West Indies, not specified		3,998	12,301	13,528	10,660	5,205	45,692
Australia		2	3		104	138	247
Sandwich Islands		1	6	28	44	76	155
East India Islands		79				21	100
New Zealand					4	15	19
Society Islands				1	6		7
Islands of Pacific, not specified						5	5
Azores		13	29	327	2,873	3,643	6,885
Bermudas						63	63
Cape de Verdes		4	15	3	7	43	72
Madeira		70	52	3	189	9	323
St. Helena			1	3	13	16	33
Canary Islands		271	6	1	8	4	290
Miquelon						4	4
Iceland					10	1	11
Countries not specified	250,000	32,894	69,801	52,777	25,911	57,260	488,643
Corsica		2	5	2		3	12
Barbary States		4	4	3			11
Aggregate	250,000	151,824	599,125	1,713,251	2,598,214	2,491,451	7,803,865

* The natives of Ireland are partly estimated on the basis of data obtained by the commissioners of emigration of New York. The total from the British Isles, given above, is from official returns to the Bureau of Statistics.

AGRICULTURAL EXPORTS.

Statement of the exports of agricultural products of the United States, with their immediate manufactures, for the year ended June 30, 1871, furnished by Edward Young, Chief of Bureau of Statistics, Treasury Department.

Articles.	Quantity.	Value.
Animals, living:		
Hogs .... number..	8,770	$61,390
Horned cattle .... number..	20,530	403,491
Horses .... number..	1,186	173,273
Mules .... number..	1,930	265,827
Sheep .... number..	45,465	86,888
All other, and fowls .... number..		23,735
Total		1,019,604

Statement of agricultural products exported from the United States, &c.—Continued.

Articles.	Quantity.	Value.
Animal matter:		
Hides and skins other than fur		$700, 604
Pork ... pounds	39, 250, 750	4, 302, 320
Hams and bacon ... pounds	71, 446, 854	8, 126, 683
Lard ... pounds	80, 037, 297	10, 563, 020
Lard oil ... gallons	147, 802	153, 850
Neat's-foot and other animal oils ... gallons	80	137
Beef ... pounds	43, 880, 217	3, 825, 666
Preserved meats		208, 362
Tallow ... pounds	33, 850, 317	3, 025, 035
Hair, unmanufactured		301, 095
Hair, manufactured		31, 679
Butter ... pounds	3, 965, 043	853, 096
Cheese ... pounds	63, 698, 867	8, 752, 990
Eggs ... dozen	5, 017	1, 423
Candles, tallow and other ... pounds	2, 321, 959	348, 368
Soap, perfumed		16, 954
Soap, other ... pounds	7, 786, 276	576, 026
Glue ... pounds	81, 110	12, 316
Wax ... pounds	365, 195	113, 070
Leather of all kinds not specified ... pounds	1, 900, 044	480, 543
Morocco, and other fine		18, 690
Boots and shoes ... pairs	301, 216	445, 466
Saddlery and harness		798, 182
Manufactures not specified		154, 514
Wool ... pounds	25, 195	8, 762
Wool, manufactures of, not specified		237, 710
Furs and fur skins		1, 590, 193
Bones and bone dust ... cwt	35, 572	55, 629
Bone-black, ivory-black, &c ... pounds	586, 236	25, 980
Total		45, 728, 368
Breadstuffs:		
Indian corn ... bushels	9, 826, 309	$7, 458, 997
Indian-corn meal ... barrels	212, 641	951, 830
Wheat ... bushels	34, 304, 906	45, 143, 424
Wheat flour ... barrels	3, 653, 841	24, 093, 184
Rye ... bushels	49, 674	44, 678
Rye flour ... barrels	6, 250	34, 135
Barley ... bushels	340, 093	200, 625
Other small-grain and pulse ... bushels		357, 893
Rice ... pounds	445, 842	22, 592
Bread and biscuit ... pounds	13, 801, 624	760, 637
Macaroni, vermicelli, and all other preparations from breadstuffs		252, 704
Total		79, 320, 609
Cotton:		
Unmanufactured, Sea-Island ... pounds	3, 212, 988	$1, 437, 539
Unmanufactured, other ... pounds	1, 459, 715, 036	216, 889, 570
Manufactures, colored ... yards	5, 083, 923	724, 841
Manufactures, uncolored ... yards	14, 832, 931	1, 776, 694
Manufactures, all other		1, 056, 601
Total		221, 885, 245
Wood and manufactures of wood:		
Boards, clapboards, &c ... M. feet	154, 630	$2, 764, 329
Laths, palings, pickets, &c ... M	2. 326	6, 896
Shingles ... M	23, 254	99, 258
Box shooks		138, 813
Other shooks, staves, and headings		4, 822, 705
Hogsheads and barrels, empty ... number	152, 230	292, 561
All other lumber		242, 474
Firewood ... cords	8, 090	19, 892
Hop, hoop, and other poles		731, 239
Logs, masts, spars, and other whole timber		241, 682
Timber, sawed and hewn ... cubic feet	7, 115, 007	1, 309, 094
All other timber		136, 403
Household furniture		1, 110, 091
All other manufactures of		781, 187
Bark for tanning		96, 195
Total		12, 795, 829
Ashes, pot and pearl ... pounds	1, 474, 954	$103, 249
Rosin and turpentine ... barrels	511, 959	1, 660, 551
Tar and pitch ... barrels	32, 584	93, 884
Apples, green or ripe ... bushels	134, 993	136, 693
Apples, dried ... pounds	1, 150, 122	79, 026
Fruit, green, ripe, or dried		138, 355

Statement of agricultural products exported from the United States, &c.—Continued.

Articles.	Quantity.	Value.
Potatoes .... bushels ..	553, 070	$432, 815
Onions .... bushels ..	56, 953	79, 114
Pickles and sauces	....	15, 857
Vegetables, prepared or preserved	....	22, 613
Vegetables not specified	....	102, 747
Clover-seed .... bushels ..	321, 192	2, 191, 662
Flaxseed .... bushels ..	282	721
Linseed-oil .... gallons ..	37, 841	35, 962
Castor-oil .... gallons ..	700	1, 254
Essential oils .... gallons ..	....	119, 311
Oil cake .... pounds ..	203, 587, 040	4, 160, 021
Hemp, unmanufactured .... cwt ..	573	5, 775
Hemp, manufactured, cables and cordage	10, 207	190, 946
Hemp, manufactured, all other	....	85, 066
Hops .... pounds ..	3, 273, 653	316, 288
Hay .... tons ..	4, 581	104, 261
Ginseng .... pounds ..	114, 221	119, 385
Salt .... bushels ..	120, 156	47, 115
Beer, ale, porter, and cider, in bottles .... bottles ..	1, 570	4, 077
Beer, ale, porter, and cider, in casks .... gallons ..	105, 213	34, 301
Spirits distilled from grain .... gallons ..	47, 660	68, 601
Spirits distilled from molasses .... gallons ..	726, 975	376, 957
Spirits distilled from other materials .... gallons ..	5, 518	6, 988
Spirits of turpentine .... gallons ..	2, 453, 554	1, 009, 508
Wine .... gallons ..	19, 217	26, 444
Molasses .... gallons ..	2, 794, 829	693, 806
Vinegar .... gallons ..	35, 244	9, 095
Sugar, brown .... pounds ..	43, 800	2, 453
Sugar, refined .... pounds ..	3, 797, 278	500, 986
Candy and confectionery	....	20, 969
Cigars .... M ..	1, 433	53, 043
Snuff .... pounds ..	18, 724	11, 683
Tobacco, manufactured	....	2, 022, 434
Tobacco leaf, unmanufactured .... pounds ..	215, 667, 604	19, 908, 797
Total	....	34, 932, 204

RECAPITULATION.

Animal production	....	$46, 747, 972
Breadstuffs	....	79, 320, 609
Cotton manufactures	....	221, 885, 245
Wood and its products	....	12, 795, 829
Miscellaneous	....	34, 932, 204
Aggregate	....	395, 681, 859

In the report of the editor, in another portion of this annual, may be found the results of other investigations of the Statistical Division. A large amount of statistical material has been prepared for other branches of the Government and for industrial organizations; and investigations are in progress, the results of which, it is believed, will serve to enlarge the usefulness of this branch of the Department, and aid in the great work of subduing the millions of yet unbroken but fertile acres soon to be brought into cultivation.

J. R. DODGE,
Statistician.

HON. HORACE CAPRON,
Commissioner.

REPORT OF THE ENTOMOLOGIST AND CURATOR OF THE MUSEUM.

SIR: During the past year an unusually large number of letters has been received from persons in all parts of the United States, desiring information on the natural history and habits of certain insects which have lately been found to injure various crops; desiring at the same time to know what remedies have been recommended to effect their destruction, or at least to diminish the losses caused by their ravages. Many new facts have been discovered within the last twelve months, by State and private entomologists, concerning the food and habits of certain insects which have hitherto been unknown. Many have been found to injure cultivated plants and trees, which formerly were thought to confine themselves merely to wild vegetation and weeds.

To give publicity to these facts it will be necessary to quote extensively from Mr. Riley, of the American Entomologist and Botanist, (a valuable journal, which, unfortunately, has been suspended for one year,) Dr. Fitch, Dr. Walsh, and other standard practical entomologists, whose works the greater number of our readers may never chance to see. I shall also give extracts from correspondence of the Department, from my own private note-book, and the results of experiments made in the Department.

To give some idea of the ravages committed by insects, Hon. Horace Greeley recently stated that if he were to estimate the average loss per annum of the farmers of the country from insects at $100,000,000, he would doubtless be far below the mark.

I will first take up the order of Coleoptera or beetles.

Tetracha, (*Megacephala*,) *Virginica*, (Hope,) a large tiger-beetle, is mentioned here, as it is said to destroy the larva of the Colorado potato-bug, *Doryphora 10-lineata*. The larva of the tiger-beetle is predaceous, and feeds upon insects, worms, &c. The specimen figured excavated in the earth a round hole, about the diameter of a common lead-pencil, from three to five inches in depth. This almost perpendicular retreat was dug in the month of June, the larva changing into the pupa and perfect insect in the course of a few weeks. Great numbers of larvæ were taken by the common method of inserting a stalk of grass into the hole, leaving the top sticking out. The underground larva, endeavoring to eject the intruding stalk, seizes it with its powerful jaws, and, pushing it upward, causes the top of the grass to shake. When this takes place, if the stalk is immediately jerked out, the larva will be brought with it, still holding on to the stem with its jaws. A larva that was kept alive to observe its habits, was placed in a common flower-pot partially filled with earth, moderately consolidated by pressure; a hole was then made in it with a lead-pencil, and the larva placed tail first in the hole, when it immediately worked itself down out of sight. The next day it fed voraciously on earth-worms and insects, as if nothing had happened. A curious habit was observed, that when the earth in which the larva was kept was watered, it invariably brought large pellets of mud in its jaws to the top of its burrow, and, commencing to build at the sides, in a very short time effectually closed the opening with a somewhat arched roof, so that its retreat could not

Fig. 1.

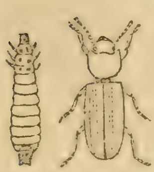
be inundated. In a short time, if no more water was poured on, and the flower-pot was placed in the sunshine, the pellets were removed one by one and the hole reopened. This larva was extremely voracious, devouring every insect which passed over its hole, not even sparing larvæ of its own species that were dropped intentionally within its reach. The pupa was formed at the bottom of the burrow. The perfect insect is said to be crepuscular, and devours other insects. It should therefore be preserved, together with the other species of tiger-beetles, as they live entirely upon animal food, and do not touch vegetable diet at all.

The rove-beetles, or *Staphylinidæ*, are long, narrow, and depressed in form, having the abdomen much longer than the wing-covers, which are very short. These insects are very voracious, and feed on various animal and vegetable substances. The young larva of a small dark-colored beetle, belonging to this family, *Aleochara anthomyiæ*, was discovered by Mr. Philip S. Sprague, of Boston, Massachusetts, to be parasitic on the larva of *Anthomyia brassicæ*, or cabbage-fly. Mr. Sprague states that a number of cases of the *Anthomyia* were examined with a microscope, which were found to contain this parasite, but he could discover no break or orifice through which the rove-beetles could have entered, thus proving, as far as he could judge, that the cabbage-fly larva was entered by the parasite before its skin had hardened into the pupa case, by gnawing a hole through the side near the extremity. This insect is therefore beneficial, and should be protected as far as possible in cabbage gardens or fields.

Fig. 2.

The larva of *Trogosita dubia* (Mels.) has been found injuring maize, and in beech nuts. Its near relative, *Trogosita mauritanica*, (Oliv.,) is extremely injurious to stored grain. In France it is termed the "Cadelle." When very numerous this insect can be destroyed only by kiln drying, which will not injure the grain materially for domestic purposes, although the process will certainly prevent germination.

Fig. 3.



The larva of a very small brown beetle, *Sylvanus surinamensis*, (Steph.,) has been found feeding in the grains of wheat, oats, maize, and rye, and it likewise injures the seeds of apples which have been preserved for planting. It was also taken in considerable numbers from holes eaten in samples of dried leaf tobacco. Several samples of tobacco were almost entirely destroyed by another brownish insect, *Sitodrepa panicea*, (Thoms,) (Agricultural Report, 1854, plate 5,) which is almost omnivorous, feeding on maize, &c., ginger, rhubarb, and even on red or cayenne pepper, and the Spanish flies, or cantharides of the druggists' shops. The fact of these insects eating tobacco is merely mentioned, as it is generally believed that no insect will touch tobacco when dried. Alum has been recommended to destroy this insect, but the only remedy we have found successful is to bake the infested tobacco in an oven heated very hot by steam.

Fig. 4.

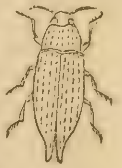
A small, blackish-brown beetle, *Platycerus quercus*, (Sch.,) commonly known as the oak horn-bug, and found in the larval and imago states in rotten wood of oak, is said by the American Entomologist to destroy buds of the pear in spring. This fact has hitherto been unnoticed by entomologists. The perfect insect hybernates. The males have large, horny jaws, somewhat similar to but smaller than the stag-beetles.

Fig. 5.

Chrysobothris calcarata, (Mels.,) (*femorata*, Lap.,) (Agricultural Report, 1868, p. 92, fig. 97,) the flat-headed apple-borer, or thick-legged *Buprestis*, which is said to injure apple, peach, and oak, deposits its eggs on the bark, and the larva is generally found on the south or southwest side of the tree, preferring trees that have been "sun-scalded." It bores into the solid wood under the bark, and is stated by Mr. Packard to remain as larva one year. Dr. Fitch, in his fifth report, 1858, states that before apple trees were introduced the larva probably fed on oak. The perfect insect appears from May to July, and may generally be found sunning itself on the trunks of the trees. To protect maple and other trees from the attacks of the *Chrysobothris*, applications of soap on the trunk and larger branches in May and during the summer are said to be an effectual remedy.

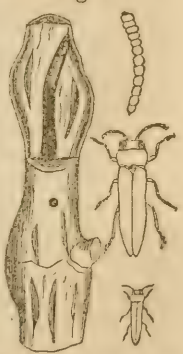
The larva of another very similar insect belonging to the same family, *Dicerca divaricata*, (Lec.,) mines in the sap-wood and under the bark of apple, beech, cherry, peach, and plum trees. The insect itself can be found from June to August on the trunks of these trees. In order to preserve the trees from these insects, it has been recommended to wash the trunks with some alkaline solution—hard or soft soap, thinned to a proper consistence with salt brine, to which tobacco stems are added—from June to August, repeating the wash after heavy rains or dews.

Fig. 6.



Some raspberry canes, sent by Mr. Charles Carpenter, of Kelley's Island, Ohio, which had been injured by some unknown insect, were received in January. At first it was surmised to be the work of *Oberea tripunctata*, or raspberry-borer, an insect which is known to injure raspberry-plants by burrowing in the pith, but after the larva had changed to the perfect insect, it was found to be *Agrilus ruficollis*, (Say,) a small wedge-shaped beetle, with a ruby-red thorax and blackish wing-covers. The injured canes presented the appearance of a swelling in the stem, forming several ridges. Mr. Saunders, in describing an injury done to raspberry canes in Canada, and ascribing it to *Oberea tripunctata*, states that "the new cane is first girdled near the tip in two places, one ring very nearly an inch below the other." All the specimens sent by Mr. Carpenter certainly presented that appearance of girdling when the outer bark was scraped off with a knife. The perfect insects came out very early in the spring, owing to their having been kept in a very warm room. Raspberry or blackberry canes presenting swollen stems and a diseased appearance should be cut off in winter and immediately burned.

Fig. 7.



An insect of the same family, *Agrilus egenus*, (Poey,) (Agricultural Report, 1868, p. 92, Fig. 103,) of a greenish, metallic color, and wanting the ruby-red thorax, was found in Virginia a few years ago in great numbers, feeding on the leaves of the locust tree, *Robinia pseudacacia*, the foliage of which was completely riddled with small holes, which had been eaten by this insect.

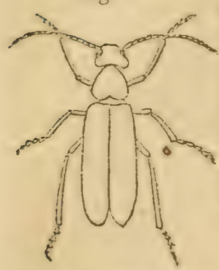
The so-called wire-worms are the larvæ of different species of click-beetles, or snapping-bugs, as they are vulgarly called. In the larval state they feed upon roots of grass, maize, potatoes, &c., and are especially troublesome in land that has been recently plowed up from the sod. *Agriotes manchus* (Lec.) is a very common species, and is said by Harris to resemble the wire-worm of Europe.

Fig. 8.

Sowing salt, at the rate of six bushels to the acre, is said by Alderman Mechi (a good English authority) to destroy them; but several farmers in this country who have tried it state that the remedy is of very little avail, for if sufficient salt is sown to destroy the wire-worms, vegetation is also injured.

A large black cantharis or blister-fly, *Epicauta corvina*, (Lec.,) is mentioned as injuring the potato plants between two and three hundred miles west of Kansas City. Specimens were sent by Rev. Cyrus Thomas from Colorado.

Fig. 9.



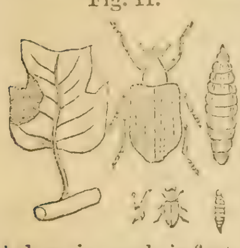
A small brown beetle, *Scolytus caryæ*, (Riley,) or hickory bark-borer, was discovered by Mr. Riley injuring hickory by boring holes in the bark. The holes made by the female for her eggs slant upward, while those made by the larvæ run straight to the sap-wood, and are as large as if made by No. 8 shot. No remedy is given.

A black curculio, with curiously sculptured thorax, *Sphenophorus caryosus*, (Oliv.,) was sent from New Jersey, where it is said to be very destructive to young plants of maize in the field. It destroys them by piercing the stems, in which the larva lives and feeds. Dr. Walsh also speaks of a *Sphenophorus zeæ*, which pierces corn in numerous places, each blade having six or eight holes of the size of a pin, or larger, and when very numerous every stalk is killed. Another *Sphenophorus* was sent several years ago from South Carolina under the local name of "Bill-bug." It had been very destructive to growing maize in the low lands of the Pedee. The plants attacked by this insect turn yellow, and many of them die. It therefore behooves our farmers to examine all unhealthy stalks of maize, and when insects are found to destroy them, to prevent their spreading.

Fig. 10.

The larvæ of a small blackish curculio (allied to *Phytobius*) were found, in June and July, in Maryland, occupying large brown blister-like spots on the leaves of the tulip tree. The parenchyma of the leaf being entirely eaten out, the outer cuticle containing the larvæ turns brown, and several stringy-like filaments, apparently of "frass," are scattered through the cavity. The pupæ are formed in little balls or cocoons of this thread-like substance, and the perfect beetle appears in eight to ten days after the pupa is formed. Six to ten of these insects were taken in each infested leaf, but whether the larvæ eat the parenchyma, or are parasitic on some other insect, has not yet been discovered. It is mentioned as rather singular that the larva of a curculio should be found in such a situation.

Fig. 11.

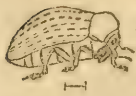


The plum-weevil, (*Conotrachelus nenuphar*,) (Agric. Rep. 1854, pl. 7,) commonly known as the "curculio," was said by Dr. Walsh to be double-brooded, he stating that the first brood at Rock Island, Illinois, appears from July 19 to August 4, and the second brood from August 23 to September 28; but Mr. Riley states distinctly that it is single-brooded, and that it hybernates in the perfect or weevil state, and not in the larval or pupal, as was formerly imagined. The beetle also is more nocturnal than diurnal in habit, and is very active at night; but during the daytime, especially in bright sunny weather, rests among the leaves and branches, or under some shelter. It was formerly stated that the female first bored a crescent-shaped cut or incision with her beak, and then

deposited an egg in the cut; but Dr. F. C. Hill, of Ohio, states that the female first bores a round hole with her snout, not straight in, but slanting backward, so that the cavity is just below the skin; she deposits her egg in the hole, and then cuts the usual crescent-shaped slit in front of it so as to undermine the egg, and leave it in a kind of flap formed by the little piece of flesh of the fruit which she has undermined, in order to meet the piece around the egg, and prevent the growing fruit from crushing it. The insect in the perfect state is said by Dr. Riley to gouge holes in peaches and apples, and also to feed on bark and tender twigs, and to gnaw holes in the leaves. In regard to the new remedy proposed this season by Mr. Ransom, of St. Joseph, Michigan, in the Prairie Farmer and elsewhere, I quote from Mr. Ransom himself: Some experiments were made by laying pieces of bark, &c., on the ground under the trees, as a shelter under which the curculio could hide. The first night, about sunset, he prepared 250 trees, and in the morning went around, and in about three hours caught six hundred and forty-seven curculios; the next day, having finished the orchard of 400 trees, he killed four thousand one hundred and seventy-one curculios. The total number of curculios killed by him in one season was seventeen thousand nine hundred and forty-five. Now, the question arises, were these insects true plum-weevils? and might it not be that some other somewhat similar insects were counted in by mistake? The Michigan Farmer, in commenting upon this article, says that the State entomologist of Illinois, and the horticultural editor of the Prairie Farmer, having been at St. Joseph, examining into the workings of the method proposed by Dr. Ransom to destroy the plum curculio, stated that the traps were pieces of bark three or four inches long, and about half as wide. Before putting them down, the ground was smoothed and the earth pressed close to the trunks, so as to leave no hiding-place for the curculio to enter. The pieces of bark were then laid close around the trunks of the trees, three or four pieces to a tree, and pressed down in contact with the earth, so that only very small openings should be left under them. The pieces laid close to the ground, with one edge touching the tree, were generally selected by the insects, whose object was to shelter themselves, while at rest, from observation and possibly from the cold. On further inquiry, this method appears to have been only partially effective, and the fruit-growers near St. Joseph found that, though they destroyed many insects by this trapping method, more were destroyed by jarring the trees. When the weather became warm, the curculios were taken under the trees in diminished numbers, while in fact their numbers were rapidly augmented in the trees. The conclusions arrived at are briefly as follows: The trapping system will help to thin out the curculio before the season for stinging the fruit commences; that it will not do to dispense with jarring the trees; and, furthermore, that pieces of bark for a short time, early in the season, when the days are sometimes warm and the nights cold, and before the peach blossoms have withered away, are useful for capturing curculios, but that after the fruit is as large as a hazel-nut this remedy is not successful. It is elsewhere recommended to place the traps of bark under the trees as soon as the frost is fairly out of the ground. Mr. Riley states that this remedy was discovered several years ago, and described by Mrs. H. Weir, of Johnsville, New York, in the Rural New Yorker, January 28, 1865, "when 161 curculios were caught under some lumber before the plum-trees were in flower." I have devoted more space to this subject than was at first intended, as it has created some sensation among fruit-growers; and it might be well for our pomologists to ex-

periment with it another season, and report their success in the agricultural journals. The old remedy of keeping hogs in a plum, peach, or apple orchard, to eat the infested fruit as soon as it falls to the ground, appears from our correspondence to be very successful when practiced for two or three years, and where there are no other orchards in the vicinity.

Fig. 12.

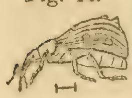


A small, dark-colored, rather broad curculio, *Cœliodes inæqualis*, (Say,) deposits an egg in or on the fruit of the grape in June or July. The larva burrows into the berry, and usually gnaws away a part of one of the seeds. The infested berry does not rot or decay, and the first sign of the fruit being stung is a dark circular dot in the midst of a colored spot, as if a red-hot needle or pin had been thrust into the berry. When the larva has attained its growth, it drops out of the fruit, and buries itself a short distance in the earth. The pupa is formed in a small cell a little below the surface of the ground. The insect appears in September, and the females probably hybernate in sheltered places. To destroy this beetle all infested berries should be sought out, and either burned or crushed under foot as soon as observed, and before the larva has made its escape.

Fig. 13.

Chestnuts, hazel, and other nuts are frequently found to contain a white, fleshy, footless grub. These are the larvæ of long-snouted, brownish-gray beetles, *Balaninus nasicus*, *B. rectus*, *&c.* The egg is deposited by the female in a hole drilled in the nut or acorn by the long beak of the insect, when the fruit is young and tender. The larva feeds inside upon the substance, and, when fully grown, leaves the nut and burrows in the earth, where the pupa is formed. There are said to be two broods, the last one probably hybernating in the earth. Mr. Akhurst, of Brooklyn, New York, who has made some experiments in breeding these insects from acorns, states that they sometimes remain in the larva state over one season, and last autumn he exhibited larvæ which had been bred from acorns the previous season.

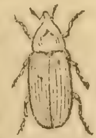
Fig. 14.



The perfect insect of another small curculio, *Anthonomus quadrigibbus*, (Say,) is accused of eating round holes in apples, plums, &c., both for food and as a place in which to deposit her eggs. In the American Entomologist, however, it is stated that it never attacks stone fruit, and never goes into the ground to change into the pupa state, but transforms in the fruit itself. Another of this genus, *Anthonomus suturalis*, (Lec.,) described by Mr. W. C. Fish, in a report to the Cape Cod Cranberry Grower's Association, is called the cranberry weevil. The female deposits its eggs, about the middle of May, in the buds of the cranberry. Selecting a bud not quite ready to open, and clinging to it, she works her snout deep into its center; an egg is then deposited in the hole thus made; the beetle climbs the stem, and cuts it off near where it joins the bud, and the shoot drops to the ground. The larva feeds inside the bud and the weevil, when mature, eats its way out. The perfect insect is also said to eat into the fruit. The only remedy that could be suggested, should the insect become troublesome, is to flood the cranberry patch, if possible, for a short time, provided it does not occur at a period when the future crop might be injured by being under water.

The perfect beetle of the plum-gouger, *Anthonomus* (*prunicida*, Walsh,) *scutellaris*, (Lec.,) bores a round hole, resembling the puncture of a pin,

Fig. 15.



(not crescent-shaped like that of the common plum curculio,) wherein to deposit her eggs, five or six holes being found in one plum, from which the gum exudes copiously. The larva, instead of living permanently in the flesh of the fruit, bores its way to the stone, and then feeds upon the kernel exclusively. The insect itself is said to feed upon the flesh of the plum, and takes wing readily. There is probably only one brood in the season. Destroying all fallen fruit, as in the case of the true plum curculio, would probably lessen the number of these pests, should they increase so as to become troublesome.

Horticulturists, growing evergreens for their beauty or effect in landscape, are frequently annoyed by finding the leading shoots of pine, hemlock, Norway spruce, &c., dying out, thus destroying the symmetry of the tree. The injury is frequently caused by the attacks of the white pine weevil, *Pissodes strobi*, (Peck.,) which deposits an egg in the terminal or leading shoot, and the larva, hatching, destroys the shoot by boring into it. The pupa is formed just under the bark, and the insect, which is of a grayish brown color, appears in April and May, after hybernating in the crevices of the bark. Some of these insects are said to come out in autumn, although they appear in much larger numbers early in the season. All shoots thus infected should be cut out and burned, and in case the larva cannot be extracted without essentially injuring the branch, one of the leading side-shoots can be selected and bound in an upright position, so as to take the place of the terminal shoot which has been cut off.

Fig. 16.

Lixus concavus, (Say,) another curculio of a lengthened form, dark-colored, and sometimes covered with a yellowish bloom, was found on the rhubarb, or pie-plant, in Washington, in the act of boring into the stalk of the leaves and depositing its egg in the hole thus made. On examining the plant many of the leaves were found to be yellow and faded. These injured leaves mostly contained eggs, and although no larvæ were found at the time, it is highly probable that the larva of this insect causes considerable injury to the plants thus perforated, as an allied European insect, *Lixus paraplecticus*, is stated to reside in the stems of *Sium* or water parsnip.

Fig. 17.

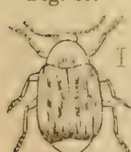
The perfect insect of *Epicærus vadosus*, (Say,) or an allied species, was found in Maryland to be very destructive to cabbages, clover, &c., by eating holes in the leaves. *Epicærus imbricatus*, (Say,) a very similar insect, was complained of as being injurious to the foliage of the apple and cherry trees.

Fig. 18.

The larva of *Caryborus arthriticus* (Fab,) was found in palmetto seed brought by Mrs. Berrian, of Washington, from Pilatka, Florida. This larva lives in the seed, eating its interior in the same manner as the *Bruchus pisi*, or pea-weevil. The seed was entirely destroyed by this insect, one only of which appeared to inhabit each seed or berry. The perfect beetles came out in May or June.

Fig. 19.

Fig. 20.

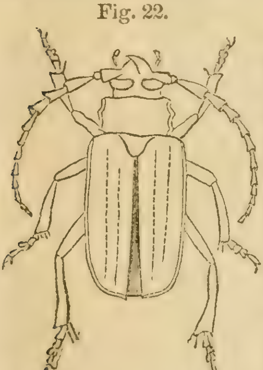


Horticulturists are well aware of the damage done by the common pea-weevil, *Bruchus pisi*, but it appears that a species hitherto unknown here has been lately introduced from Europe, which threatens, if not checked, to help its relative, *B. pisi*, in the work of destroying peas, &c.. in this country. This insect, *Bruchus granarius*, is said to have been introduced into New York in some seed brought by a gentleman from Switzerland

and presented to the Farmers' Club. In Europe it is said to be abundant as early as February, on flowers, and is a most destructive insect, the larvæ feeding in seeds of peas and beans, frequently destroying more than half the crop. The natural history of our pea-weevil, *B. pisi*, much resembling that of the imported *B. granarius*, is as follows: The egg is deposited by the female in a puncture made on the outside of the young pod exactly opposite a seed. This is done chiefly during the night or in cloudy weather. The larvæ, when hatched, penetrate through the pod immediately into the pea beneath, and feed upon its interior. In the meantime the puncture made by the young larva, being so very minute, heals up, leaving scarcely a vestige of a scar. The pupa is formed in the autumn in the cavity of the pea, made by the larva having eaten out part of the interior, and when it arrives at maturity it makes its escape by gnawing a small hole through the rind of the seed, the larva having previously eaten its way to the inner surface, leaving only a thin pellicle. The *Bruchus granarius* in England is very destructive to the pea, and in general remains in the larva state until the following spring; but if the weather is very warm the perfect insect appears the preceding autumn. The larva has the curious instinct to leave the most vital parts of the seed to the last. The usual remedy is to steep the seed before planting, in very hot water, so as to kill the inclosed insect, taking care, however, not to injure the peas themselves. A correspondent in the American Entomologist recommends that the peas be put in bags and preserved until the second year, when all the insects will have perished. Other insects belonging to the same family, *B. varicornis*, *sinuatus*, and *obsoletus*, are very destructive to the field bean in this country, sometimes five to ten insects being found in one bean.

Fig. 21.

Fig. 22.



The roots of the grape vine are frequently much injured by two very large yellowish-white grubs, which Mr. Riley states are the larvæ of the large, long-horned, brownish beetles, *Prionus imbricornis*, (Linn.,) or the tile-horned prionus, and *P. brevicornis*, (Fab.,) *P. laticollis*, (Drury.) These larvæ cut for themselves cylindrical holes through the heart of the root, frequently leaving only a thin shell of bark, and probably live in the larva state three years. They transform into pupæ in smooth oval chambers in the earth when in confinement, and in a state of nature probably change in the roots about the end of June. The perfect insect appears about three weeks after the pupa is formed. *P. imbricornis* is said to feed on roots of Osage orange, corn-stalks, and decaying oak wood, as well as on grape vine; and *P. laticollis* on decaying wood of apple, poplar, oak, roots of grape vine, pear, and Osage orange. No remedy has yet been proposed for their destruction, except to kill the perfect beetles wherever found. There is another insect which injures the roots of the grape vine, *Ægeria polistiformis* (Har.,) which somewhat resembles the last named insect in the larval state. (Agricultural Report, 1854, pl. 6.) The larva of the *Prionus*, however, is a very large, yellow, footless grub, with a brownish head, while the *Ægerians* can be readily recognized by their rounder form, smaller size, and the rudimentary legs on the under side of the seventh to the tenth segments of the body, taking the head as one segment.

To destroy the well-known locust-borer, *Clytus* (*Arhopalus*) *pictus*, or *flexuosus*, a beautiful variegated black and yellow beetle, it has been recommended to apply soft soap to the trunks of very young trees every summer, about the first of August, or earlier, in the Southern States. Another insect of the same family, *Clytus saggittatus*, Germ., (*pubescens*, Hald.) was reared during the last season from dry pine wood. The colors are brown with yellowish-white markings.

Fig. 23.

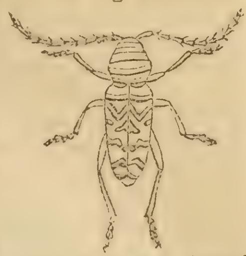
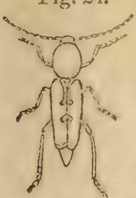


Fig. 24.



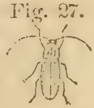
The perfect beetle of *Heliomanes bimaculatus*, Say, just emerged from the pupa case, was found in a hole in the wood of a walnut branch, where it had evidently been bred. This insect, therefore, may be classed as injuring the walnut. It resembles very strongly in appearance and habits the *Tessaropa tenuipes* of Haldeman, which also feeds in the larval state upon the wood of hickory and walnut. This insect is figured here, as it is said to be a very rare insect in collections, and not heretofore figured. Another small, long-horned beetle, *Leiopus xanthoxyli*, was found by Dr. Shimer to undermine the bark of the prickly-ash when the wood had recently died. None of the last three mentioned insects can do much damage, and are merely mentioned and figured as feeding on substances not hitherto known.

Fig. 25.

Fig. 26.

As the elm-tree beetle, *Galeruca calmariensis*, Fab., has been exceedingly injurious to the elm trees during the past season, although the natural history and remedies were described and the insect figured in the Agricultural Report for 1867, it will not, perhaps, be out of place to give it another short notice, as apparently no steps have been taken to arrest its progress. The eggs of this beetle are deposited in clusters on the under side of the leaf in May and June. These eggs are oval and are arranged in two or three rows together along the ribs of the leaf, and are fixed by one end to the surface. The larvæ, when hatched out, eat the soft inner substance of the foliage, leaving the net-work of veins and ribs, causing the leaf to assume a scorched and brown appearance. When fully grown, the larvæ, as they spin no silken web to let themselves down by, descend to the ground by the limb, if undisturbed. The pupa is formed immediately in the neighborhood of the trunk, on the surface of the ground, or under loose stones near the tree, and resembles in size and color grains of whitish wheat. They remain in this helpless and almost motionless state a few days, when they may be destroyed readily with hot water, or by crushing under foot. The perfect beetles appear in a few days, and immediately fly up into the tree to lay eggs for a second generation, which frequently destroys every leaf on the tree. This insect, imported from Europe as early as the summer of 1837, destroyed the foliage of the elms in Sevres, France, and in Germany, in 1839, trees were very much injured. I have observed that the American elm is not so much injured by these insects in Washington as the European species. Syringing the trees with strong tobacco-water has been tried with some good effect, but the larvæ not touched by the fluid are merely knocked down by the concussion, and, if nearly ready to change into pupæ, effect their transformation where they fall. It has been recommended to place around each tree small, tight, square boxes or frames, a foot or

Fig. 27.



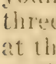
eighteen inches in height, sunk into the earth, the ground within the inclosure to be covered with cement, and the top-edge of each frame to be covered with broad, projecting pieces of tin, like the eaves of a house, or the letter T; or painted with some adhesive or repellent substance, as tar, &c. The larvæ, descending the tree, being unable to climb over the inclosure, would change into helpless pupæ within the box, where they could daily be destroyed by thousands. Those hiding within the crevices of the bark of the trunk could easily be syringed from their hiding places.

The striped cucumber-beetle, *Diabrotica vittata*, (Fab.,) during the past

Fig. 28.

season has been very destructive to young cucumber, melon, and squash vines, and even to the blossoms of the pear, cherry, and apple trees. The larvæ of this beetle in May and June eat the bark of cucumber and other plants, and frequently perforate and hollow out the lower part of the stem which is beneath the surface of the ground, and the upper part of the root. Occasionally when the supply below fails, they are found in the vine just above the ground. The larva arrives at maturity in about a month or more after the egg is laid, and is found boring into the squash and cucumber vines as late as October. The pupa is formed in a smooth earthen cavity in the ground. There are two or three generations each year, according to latitude and length of winter. Dr. Shimer states that it hybernates as a pupa in the ground; but Mr. Riley differs with him, and states that it hybernates as a perfect insect. The perfect insect does great damage by eating holes in the seed, leaves, and young foliage. In the American Entomologist it is mentioned that wide-mouthed bottles filled with sugar-water hung in the trees, and fires built at night, might materially reduce their numbers, and these remedies should be tried next season. In Mr. Riley's report he recommends inclosing the young vines in boxes open at the top and covered with millinet, or sprinkling the vines in the morning with Paris green—one part to four or five of flour—or with hellebore. Paris green is a deadly poison, however, and should be used with care. In connection with these boxes it may be well to mention a plan practiced in Florida to strike cuttings in well-drained lands, and to preserve young seedlings from insects. A square hole is dug in the earth from three to five inches in depth, with almost perpendicular sides, the ground at the bottom well stirred up, or the bottom earth taken out and good earth put in. The cuttings or seeds are then planted, the hole is covered with a single piece of glass, and loose earth is scraped around the edges of the glass to render it insect-proof. It then forms a miniature hot-bed and shelter, until the young plants are old enough to resist the attacks of insect enemies, when the glass can be removed and the earth drawn around the roots. In wet, cold situations, the holes could be made on the summit of little mounds.

Fig. 29.



The foliage of the grape is very much injured by a small purple or steel-blue beetle, *Graptodera chalybea*, (Illig.) or the grape-vine flea beetle. These insects appear in May, and destroy the leaves and buds by eating holes through them, a second brood appearing in July. The perfect insect hybernates under stones, bark, or in the earth, near the plant. It feeds also on the foliage of elm, plum, black alder, &c. To guard against its ravages, it is said by the American Entomologist that "clean culture and general cleanliness in a vineyard will to a great extent prevent the insect's increase," and that the larvæ can be destroyed by an application of dry lime used with a common sand-blower or bellows. This has been found more effectual than either lye or soap-suds, and is the safest, as lye, if used too strong, will kill the leaves.

The Colorado or western potato-bug, *Doryphora 10-lineata*, (Agricultural Report, 1867, page 63,) is still traveling rapidly eastward. The first notice of this insect was in the Prairie Farmer, August 29, 1861, and it is said to have made its appearance in the far West, and to have traveled east about three hundred and sixty miles in six years, or sixty miles a year. It feeds on the potato, tomato, egg-plant, horse-nettle, *Datura Wrightii*, Jamestown weed, ground cherry, &c. According to Professor Verrill's excellent description of the habits, &c., of this insect, the eggs, to the number of 1,000 to 1,200, or even more, are deposited by the female on the young leaves of the potato; these eggs are attached by one end to the under node of the leaves, usually in clusters of one to two dozen. The larvæ hatch in a few days; there are several broods annually, and the last brood passes the winter as pupæ under the earth. The pupæ are formed under ground, and remain, during the summer, as pupæ from ten to twelve days. The insects, after laying their eggs, do not die, as most insects do, but appear to live a long time, Professor Daniels, of the Wisconsin University, having kept a female alive six weeks after she had laid 1,200 eggs. Professor Verrill recommends Paris green, mixed with eight to twelve parts of wheat-flour or with eight parts of wood-ashes, dusted over the insects when the plants are wet with dew. He, however, very prudently adds: "It may be questioned whether it is safe or advisable to mix dangerous mineral poisons with the soil, for the arsenic and copper will remain in the earth, and may be absorbed by growing vegetables, or cause mischief in other ways." It is also stated in the American Entomologist that Paris green (arsenite of copper) is a slow but dangerous poison, and when dusting plants with it the greatest care should be taken that the wind may not carry it toward the person of the operator. It may even injure the soil if used repeatedly. Small doses of arsenic have rather promoted the growth of rye, but arsenite of copper is much more virulent in its effects, and other crops may be essentially injured by it. A very thin dusting with Paris green, mixed with flour to reduce its strength, will kill the insects, but if used too freely it becomes injurious to vegetation. Professor A. J. Cook, of the Michigan Agricultural College, says: "Some of our potato vines and egg-plants have been totally ruined by a too free use of this poison;" and adds, "We use one part of mineral to five parts of flour."

To ascertain whether the plants would readily take up the arsenic sufficiently to become hurtful, an experiment was made in the Department by planting some healthy peas in two flower-pots, one containing merely common earth, and the other earth mixed with a quantity of Paris green. The peas in the first flower-pot germinated and grew finely, while those in the Paris green did not even sprout, but rotted in the ground. A few well-sprouted peas were then taken from the healthy pot, and placed in the flower-pot containing the arsenite of copper. The next morning all the peas were found dead, proving that if Paris green be used too freely the soil is thereby injured and rendered unfit for culture. This dangerous remedy has been used already to such an extent that it is stated 12,000 pounds were sold in one season at La Crosse, Wisconsin, for the destruction of these insects.

The Colorado potato bug is now reported in Minnesota, Wisconsin, Michigan, Indiana, and Ohio. On the northern side it is said to have reached Canada. It is held that these insects possess poisonous qualities when handled, and many instances are reported of injuries produced by gathering or crushing them in the naked hand.

There is another beetle which very much resembles the true Colorado potato-beetle, the *Doryphora juncta*, (Germar.) It has been

found in Alabama feeding on egg-plants and potatoes, and also on the *Solanum Carolinense*. In Alabama it was said to be especially destructive to the foliage of the egg-plant. The general appearance of these two insects, in size, color, and markings, is so much the same that it is difficult for a person not an entomologist to distinguish them at first sight. The real potato bug, however, has *ten* stripes on the wing-cases, while the false one has only *eight*, or, in Mr. Walsh's own words, "the difference between *D. 10-lineata* and *juncta* is as follows: In *D. juncta* the second and third stripes are always united behind, and sometimes before, and the edges of all the stripes have a single *groove* and a single row of punctures, while the legs are rufous, with a black spot in the middle of the front of all the thighs."

Fig. 30.

The Rocky Mountain grasshopper, *Caloptenus spretus*, (Uhler,) has been very destructive in the far West, and we have received numerous letters from Utah and elsewhere describing their ravages. This insect resembles our commonest species in the Eastern States, the red-legged grasshopper, *Caloptenus femur-rubrum*, (Degeer,) in size, shape, color, and ornamentation, but it has much longer wing-covers and wings in proportion to its size. Rev. Cyrus Thomas, who has made this order his especial study, and who has observed these insects in their native wilds, states that it is quite a distinct species from the *femur-rubrum*, and that when the Rocky Mountain species makes its migrations to the low lands it frequently alights amid the common eastern species, also living there, but never mixes with them in the least, and when the migratory species leaves the place they fly away in masses without taking any of the common species with them. These insects fly in numbers so immense and to such distances, and breed in such out-of-the-way and sterile places—generally coarse-gravelly table lands where vegetation is very scant—that, as yet, no remedy has been discovered, at least when the insects are in the perfect state and furnished with powerful wings. A correspondent in Utah states that fire and water have been tried with but little effect, and that he despairs of ever getting entirely rid of them. When in the larva state and incapable of flight, they may be destroyed in limited numbers by rolling the land with heavy rollers, or setting fire to the grass in circles in the spring; but this would be impracticable on a large scale, as the first legions that produce the second brood, doing the greatest damage, are mostly bred in waste places where only Indians and wild animals roam. A planter in Texas writes in a Louisiana paper: "As soon as the grasshopper has laid its eggs let the planters plow their fields and turn the soil over and the eggs under a deep layer of soil. This layer of soil will crush the eggs, and thus destroy the spring crop of grasshoppers. This experiment has been made on small spots of ground where myriads of eggs were deposited, and not a grasshopper came from under those layers of earth that covered the eggs." This no doubt would be very good to protect certain fields or gardens from the injuries inflicted by this insect when in the larva and pupa state, but it would be no protection whatever from the winged hordes that migrate later in the season. The common red-legged locust or grasshopper, *C. femur-rubrum*, was very destructive last year to fruit trees, grass, &c. In parts of

Fig. 31.

Fig. 32.

Maryland and Pennsylvania these insects also migrate from field to field, when in great numbers and short of food, but never take the long flights their western relative accomplishes with its larger and more powerful wings. Turkeys, domestic fowls, and birds serve to keep their numbers down in the Eastern States; they can also be readily caught in drag-nets made of cotton cloth or canvas swept over the grass early in the morning when they are somewhat benumbed and inactive.

For destroying cockroaches it has been recommended to strew pulverized borax freely in and about their haunts. This, however, has been tried and found useless, at least as far as the so-called croton bug, *Ectobia germanica* is concerned, which feeds freely on red wafers, vermilion, &c. In a library they were killed by a mixture of Paris green, starch, and glycerine; before dying, however, they stained the books and papers so much that the remedy was found to be as bad as the disease, and it was therefore discontinued. It would be dangerous to use this remedy about the kitchen or pantry on account of the Paris green.

The imported currant-worm or saw-fly, *Nematus ventricosus*, (Klug.,) was very destructive last season. The insect is stated to have been imported first in the neighborhood of Rochester, and to have traveled about twenty-five miles a year. The perfect fly comes out of the ground about April or May, and lays her eggs along the principal veins on the under side of the leaves. The larvæ have twenty legs, black heads, and are of a greenish color, spotted with black, but after the last molt they become entirely of a green color, with large, dark, eye-like spots on each side of the head. When fully grown the larvæ are about three-fourths of an inch in length. They then burrow into the earth, or hide under dead leaves, and spin a thin oval cocoon of brown silk, in which the pupa is formed. The perfect insect appears about June or July, and the second brood does not come out until the following spring. The native currant-worm, *Pristophora grossulariæ*, (Walsh,) is said not to be as injurious as its foreign relative, and differs from it by being, in the larval state, always of a uniform green color, without the black dottings always found on the imported species, except after the last molt. The cocoon is also spun among the twigs and leaves of the bushes on which it feeds, and it does not go under ground to form its cocoon. The insects are only about three-fourths the size of the imported pest, and the sexes are alike in coloration, while the female of the imported species has the body mostly of a bright honey-yellow, the male being principally black; the venation of the wings also varies. The larvæ of both feed upon the currant and gooseberry, and some were brought to this Department which were said to have been found feeding on the leaves of the strawberry, planted around the currant bushes. The best remedy is dusting the bushes with pulverized white hellebore—the root of the *Veratrum album* of Europe—which may be found at any druggist's. The success of our native species, *Veratrum viride* of Gray, the American white hellebore or Indian poke, has not yet been reported on, but should be tried. Syringing the plants with a strong decoction of hellebore is said to kill the insect also, and although it is poisonous in large quantities, the American Entomologist states that in minute doses there is no reason to be afraid of it. Dr. Fitch states, as a proof of its innocuous properties, that it has long been in use as the basis of certain snuffs. It would be well, however, to wash the fruit before using it.

Fig. 33.

The pear slug, *Selandria cerasi*, a brownish-green, slimy slug, feeding upon the leaves of the pear tree, deposits its eggs *singly* in June, in incisions made by the piercer of the female under the skin of the leaf. The larvæ, hatching, eat the substance of the leaf, leaving the veins and under skin untouched. The pupa is formed in oblong oval cavities under ground. The insect appears in about fifteen days after the slug has gone into the ground, in June and August, and lays its eggs for the second crop, which go into the ground in September and October, and remain until the following spring, when the perfect flies come out to lay their eggs on the foliage Mr. Saunders, of Canada, states that this insect is readily destroyed by dusting the tree with air-slacked lime. Coal-oil will injure the trees, and road dust is of little value when dusted over the trees. For another insect of the same genus, Harris recommends syringing with strong soap-suds. The rose slug and other injurious slug worms can be destroyed by dusting the plants with the powdered hellebore, or syringing with a strong decoction of the same root.

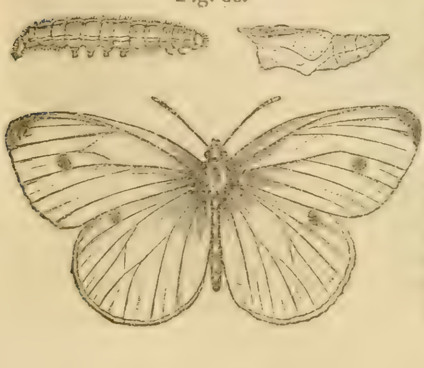
Fig. 34.

The perfect insect of the potter wasp, *Eumenes fraterna*, is beneficial, as it stores its singularly formed mud-nest with living but apparently paralyzed caterpillars as food for its larvæ. A single nest taken this season was found to contain sixteen to eighteen caterpillars, and all of them a species feeding on the willow. In Massachusetts it is said to store its nest with caterpillars of the canker worm. The larvæ of the wasp itself is subject to parasites, as a species of two-winged fly (*Toxophora?*) was raised from the vase-like clay nest of a potter wasp found in Maryland.

Fig. 35.

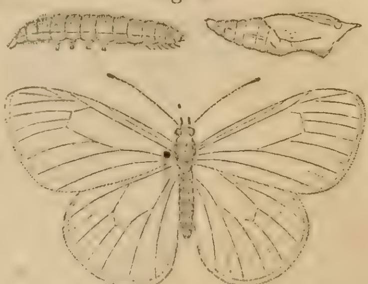
A butterfly has lately made its appearance in the neighborhood of New York and Long Island which is new to the gardens there, the caterpillar of which has already done very great damage. This insect is the common cabbage-butterfly of Europe, *Pieris rapæ*, (Linn.,) called by the Canadians *ver à cœur*, or heart-worm, from the habit it has of not only eating the outside leaves, but of destroying the heart of the cabbage. It was probably introduced into Quebec in 1856 or 1857 from Europe, in the egg state, on the under side of cabbage leaves thrown out from some vessel, and in 1864 it had not extended more than forty miles from Quebec as a center, but in 1865 it had found its way into New Hampshire and Vermont, and in 1869 was said to have been found in Hudson City and Hoboken, and no doubt the coming year it will spread into Pennsylvania. The females deposit their eggs on the cabbage. The caterpillars are of a green color with black dots, having a yellowish stripe down the back and a row of yellow spots on each side, and feed upon the leaves and bore holes in the solid head of the cabbage, rendering it filthy and unfit for use. The pupæ are suspended by a web of silk at the end of the body, into which the hooks of the tail are twisted, and by a thread of silk around the back, which is fastened

Fig. 36.



to the board, fence, or stone under which they transform. When about to change, the skin of the back of the chrysalis splits open, and the perfect butterfly comes out, at first with wings small and flaccid, but in a very short time they begin to expand, until finally they have attained their regular size and the butterfly is able to use them in flight. It then mates, and deposits its eggs on plants of the cabbage family. The first butterflies appear in Massachusetts in April, and during the summer. The change from caterpillar to perfect insect occupies only about eight days, but the pupae or chrysalides of the late broods remain all winter, and are only hatched out the following spring. These caterpillars feed not only on cabbage but also on cauliflower, mustard, turnip, mignonette, nasturtium, and are even said by Curtis to be found on willow in England. The male butterfly is yellowish-white with black tips and one round black spot only on each upper wing, while the female has two and sometimes three. The American Entomologist states that as a remedy salt has been found more effectual than either tobacco, cresylic acid, soap, or guano, and that by laying pieces of board between the rows of cabbages, supporting them about two inches above the surface of the ground, the worms will resort to them to undergo their transformations, and can then be easily destroyed. The saponaceous compounds of cresylic acid are also recommended; but Mr. P. T. Quinn, of New Jersey, gives the following as his experience in combating this insect. On his return from California last summer he found his cabbages infested with worms which threatened total destruction. After trying various remedies, he found this recipe to be the best: Twenty parts of superphosphate made with slush acid, one part of carbolic powder, and three parts of air-slacked lime, mixed well together, and thoroughly dusted into each head four times at intervals of four days. The result was the saving of seventy-five thousand cabbages and a loss of only five per cent. It would be well for cabbage-growers also to offer a small reward to children for every white butterfly caught and destroyed early in spring among the cabbages, as it is these comparatively rare butterflies that originate the immense number of caterpillars which, later in the fall, destroy the whole crop.

Fig. 37.



We have two other white butterflies in the United States which injure cabbages, but not to such a degree as the *P. rapæ*, as they confine themselves principally to the leaves, and do not burrow into the heart of the plant. In the Northern and Eastern States the pot-herb *Pontia* of Harris (*Picris oleracea*, Bdv.) is most abundant. It differs from *rapæ* by being wholly white, without any black spots or markings. The southern cabbage butterfly (*Pieris protodice*, Boisd.) is found all along the southeastern Atlantic coast from Connecticut to Texas. It is exceedingly common in Maryland and Virginia, but does not appear to do much damage in general to cabbages in this neighborhood,

Fig. 38.

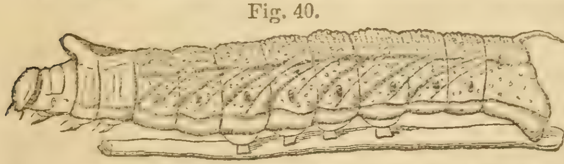
where it has been frequently found feeding on the leaves of turnip. The wings are white, with much larger, longer, and more irregularly-shaped black markings than *rapæ*, and these round black spots are never so distinctly marked. Their transformations are effected very much in the same manner as *rapæ*, and the same remedies may be used.

Sensational reports have appeared from time to time during the past year in various local papers, stating that individuals have died from being poisoned or stung by the caudal horn or tail of the common green tomato or potato worm, *Macrosila* (*celeus* G. and R.) *quinquemaculata*, Steph., and many persons have been so much alarmed by these reports as to abstain entirely from gathering their tomatoes. This is simply ridiculous, as the caterpillar has no power of charging tail foremost; and even if it had, there is no poison whatever in either the tail or head. It is true, if crushed, the larva will eject from its mouth a greenish semi-fluid substance, which is merely the undigested and recently-swallowed food. Had there been a poison about these much-abused caterpillars, there would have been dreadful mortality among the turkeys in Maryland for many years past, as these birds are used to extirpate the tobacco worms, a closely allied species, feeding upon them voraciously, even fattening on them, and without any symptoms of poison.

Fig. 39.

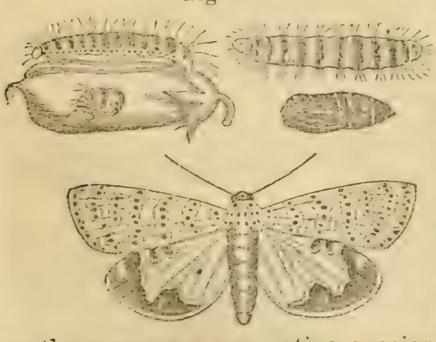
It may be interesting to entomologists to know that last year the caterpillar of *Spinx eremitis*, Walk., (*sordida* of Har.,) was taken feeding on the mountain mint in the autumn. This larva was described by Mr. Litner of Albany, N. Y., as feeding on spearmint or wild bergamot. An outline of the caterpillar is given, as it is rare and little known.

Fig. 40.



The larvæ of a very common and beautiful moth, well known to entomologists, *Utetheisa* (*Deiopeia*) *bella*, (Drury,) were discovered late in July and August to be abundant in the seed-pods of the rattle-box, (*Crotalaria.*) The caterpillar, having first eaten a large round hole in the outer envelope or shell, enters the pod, where it hides itself, and, undisturbed by outside influences, devours the seeds. This habit of concealing itself in the pod renders finding it very difficult, even when the beating-net is used to sweep the meadows. Dr. Harris formerly suggested that as the larva of a European species is said to feed on the mouse-ear, our native species might do the same; but, although diligently searched for, it has not yet been taken here on that plant. The moth, which is partly diurnal in habits, is of a yellow color, beautifully and irregularly marked with white, in which are several distinct

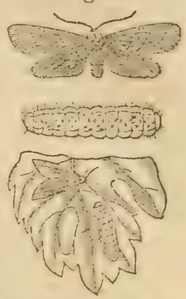
Fig. 41.



round black spots. The under wings are rose-colored or light crimson, with black edging. The larva is also yellow, with black and white rings, and the chrysalis is black and yellow, and remains a chrysalis, or pupa, in the summer a week or ten days. The larva is also said to feed on lupine.

The larva of *Acoloithus falsarius*, Clem., has been found on both the grape vine and the Virginia creeper, (*Ampelopsis quinquefolia.*) These caterpillars were found in July in Maryland, either solitary or two or three together, eating small holes in the leaves. When kept in confinement they spun small parchment-like cocoons among the dead foliage and rubbish in the bottom of the box in which they were confined, and the perfect insect appeared in ten to fourteen days after the cocoon was spun. The insects, in the perfect state, resemble very much the American forester of Fitch, *Acoloithus* (*Procris*) *Americana*, Bdv., (Agricultural Report, 1854, pl. 6,) but are only half the size, and do not have the anal tufts; the collar is of a paler orange, divided on the top by a black point, and the rest of the insect is of a somewhat bluish-black color. If they are found to increase so as to become injurious they may be destroyed by syringing the vines with whale-oil soap-suds, or a wash of hellebore and water.

Fig. 42.



The *Samia* (*Attacus*) *cynthia*, or ailanthus silk-worm, introduced for its silk-producing qualities in 1860 and 1861, has become acclimated in several of our northern cities on the Atlantic coast, but has not yet been utilized, as far as we can learn, in this country. Mr. Andrews, of New York, states, however, that he is of the opinion that *S. cynthia* "is the moth best adapted to our northern climate as a silk-producer, and has received a specimen of sewing silk made from its cocoon, which has strengthened his previous favorable opinion." Although this insect has increased to such a degree in some places as to become almost a nuisance, an attempt was made during the past year to induce the Government to re-introduce the insect, which is already naturalized and abundant. Mr. Riley, in the American Entomologist, speaking on this subject, says: "The insect has become wild, and is increasing around Baltimore, Philadelphia, Chicago, and Brooklyn, and a certain individual, totally ignorant of what has been done in past years, is soliciting Government aid in the introduction of this worm." Mr. Riley, five years ago, made extensive experiments, and in the Prairie Farmer of April 18, 1866, stated that its cocoon was of no more value than some of our native silk-worms.

Attacus pernyi, another silk-producing insect from Manchouria, and feeding on oak, has been successfully raised to the perfect or moth state, by Mr. John Akhurst, of Brooklyn, New York, but not in sufficient numbers to warrant any report upon its silk-producing qualities in this climate. A third so-called foreign silk-worm, *Antherea yama-mai*, or Japanese silk-worm, feeding on the oak and apple in the open air, has also been experimented on by Mr. Andrews and Mr. Akhurst. The great trouble with the insect at present appears to be that the eggs hatch out before there is sufficient oak foliage for the young caterpillars to feed upon. Mr. Riley states that his experience with the Japanese silk-worm the past summer was very unsatisfactory, and that in 1869 the experimenters in England also met with poor success; but notwithstanding these unfavorable reports, it would be well to try it another

year before making any decision as to its adaptability to this climate and its silk-growing qualities.

During the last year an experiment was made on a rather extended scale as to the feasibility of feeding the common Chinese mulberry silk-worm (*Bombyx mori*) on the leaves of the Osage orange, (*Maclura aurantiaca*,) a plant now plentiful in the Western States, where it is used for hedges, and is found growing wild in the Southwest, where it is known as *Bois d'arc*. Mr. Samuel Cornaby, of Spanish Fork City, Utah Territory, writes the following letter:

Having been engaged in silk culture for three years past, I take the liberty of submitting to you a report of what I have done. In 1867 Mr. Albert K. Thurber, of this place, on his return from a visit to London, England, presented me with a few silk-worm eggs of the old French variety. They made sixteen cocoons, producing three female moths. The following year I raised five hundred worms, but not having sufficient mulberry leaves to feed them I fed part of them on Osage orange. They ate it with avidity; all did well, and made cocoons of good size and color. Last season (1869) I fed five thousand worms on Osage orange and they made five thousand cocoons. This season I am feeding ten thousand worms on Osage orange and they are doing well. I would here remark that I have never found a diseased worm since I commenced raising silk.

I have fed a portion of my worms each season on mulberry and a portion on Osage orange, and those fed on the latter have thrived and done as well as those fed on the former. I do not suppose Osage orange is preferable to mulberry to feed silk-worms, but it may be of importance to some to know that they will do well upon it. I have fed worms on the two kinds of feed in close proximity, and have known them to leave the mulberry and go to the Osage orange. The dryness of our climate and the absence of thunder-storms during the feeding season, render Utah particularly adapted to the raising of silk, and perhaps it may be more favorable for feeding Osage orange than a moist climate.

Not having sufficient knowledge of the quality of silk to test it, I sent some cocoons to Mr. Muller, of Nevada City, California, to be reeled and tested, and he reports that the silk is, to all appearances, strong and of excellent quality. I intend to make a business of silk culture as fast as circumstances will permit.

These facts having been doubted by some who had been unsuccessful in raising the silk-worm on Osage orange, a letter was addressed to Mr. Cornaby, requesting further particulars of his experiment, and in his answer he reiterates his former statement and adds:

If any additional testimony is necessary to confirm my statement, I can give the names of as many responsible persons, *under seal*, as may be required, as the facts are quite familiar to all the inhabitants of this town, and the greater part of the county.

This season I have fed upward of ten thousand worms on Osage orange, and they have all spun—the box of cocoons I sent you being an average sample of the crop. This is the third season I have fed and propagated the same worms entirely on Osage orange, and they show no signs of deterioration; on the contrary, it was remarked by many this season, who had seen them during the past three years, that they looked larger and better than they had ever seen them before. That portion of my crop fed on mulberry the past four years shows no perceptible difference, hatching out and spinning about the same time as those fed on Osage orange.

I would like to have the relative qualities of the silk thus differently fed thoroughly tested, and would be pleased to forward specimens of each to any one who could do so.

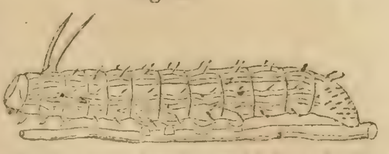
My worms hatched out this season on the 8th of May, and spun on the 19th of June, feeding forty-two days, this being seven days longer than previous seasons, owing to a cold storm that occurred in May, lasting about one week, rendering them almost inactive during that time; and I have used no artificial heat either at hatching or during the feeding time.

I have paid particular attention to cleanliness and ventilation in my cocoonery, keeping the doors and windows almost constantly open, even during the night when the weather was favorable. I attribute my success mainly to our fine dry climate. We have no dews, and rain and thunder-storms are of rare occurrence during feeding season.

A large black caterpillar with yellow longitudinal stripes, and having two black projecting processes or horns on the second segment of the body, and black prickles on all the other segments, *Anisota senatoria*, (S. & A.,) is sometimes extremely abundant in Maryland, doing considerable injury to the oak. The eggs are deposited in clusters under leaves at the end of

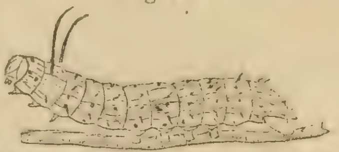
the branch. The larvæ are social in habits, and feed together in companies, attaining their full size in August and September when they bury themselves six or eight inches in the earth, to change to pupæ, and the following summer make their appearance in the perfect or moth state. The females are of a yellow-ochre color, crossed with a dark band, and have a white spot in the middle of the upper wing. The males are much smaller, and have somewhat transparent wings of a reddish brown, having a white spot on the upper wing also.

Fig. 43.



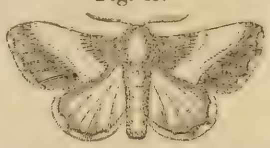
A similarly formed caterpillar, but of a green color, with black horns, shorter prickles, and a yellowish lateral line, shaded near the end with rose color, (*Anisota* (*Dryocampa*) *rubicunda*, Fab.,) does considerable injury to the silver maples in Washington, where there are two broods annually. The moth is a most beautiful insect, the upper wings being of a delicate yellow and rose, or pink color. As both these insects in the larval state are more or less gregarious and keep together, they can readily be seen and destroyed when feeding on the foliage.

Fig. 44.



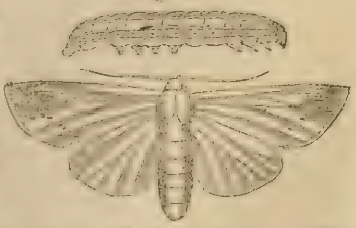
The tent caterpillar, *Clisiocampa Americana*, Har., which forms the large cobweb-like nests in orchards, in June and July, was very destructive in some localities last year. The eggs are laid on the twigs in bunches numbering from two hundred and fifty to four hundred, placed side by side in perfect rows around the twig, and are covered with a gummy matter. They may be readily seen in winter, when the foliage has fallen, and the twigs are bare. The pupæ are formed in slight cocoons in crevices of bark, under boards, &c., and the insect comes to maturity in twelve to eighteen days. It is of a brownish-yellow color, with two oblique rust-brown, and nearly parallel lines running across the wings. The best method of destroying them is to tear down the nests when and wherever found. This can be done readily with a long mullen-stalk or a brush of twigs affixed to a long pole, and when the caterpillars are beaten to the ground they can be crushed, or, as they collect together on the trunks during their last molting period, they can be slaughtered in masses. The best remedy is to search for and destroy the egg-clusters in the orchard when the trees are leafless.

Fig: 45.



The grass or army worm, *Leucania unipuncta*, Haw., though it made its appearance in some places, was not especially troublesome during the last season. The eggs are probably deposited at the base of perennial grass-stalks, and the larvæ at times appear in immense multitudes in the Northern, Middle, and Western States, where they destroy grass, grain, and other crops. Leaving one field, after having eaten it out, they march or crawl to those in the neighborhood in search of food; hence the vulgar name of army worm. The pupæ are formed in a rude earthen cocoon, and remain as pupæ two to

Fig. 46.

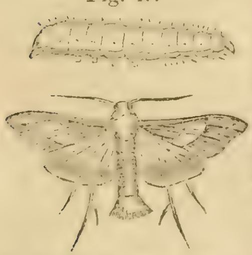


three weeks. The insect by day hides in tufts of grass. When the larvæ are migratory, or on the march for food, their march is stated to be at the rate of two to six rods per hour. These pests are said to multiply much faster in dry seasons when the swamps are dry, and when they are thus multiplied a wet season and overflowing swamps drive the insects from their lurking places in flocks, and they alight here and there over the country. There is generally but one brood in the more northern States in one season, but in the South there are probably two, the last of which hybernates as pupæ. Several remedies have been proposed for their prevention and destruction, among which may be mentioned burning over the meadows in winter or very early in spring, or plowing late in the fall or early in spring, which will probably destroy all their eggs. Judicious ditching will prevent their migration from infested fields to those as yet uninjured, and these ditches should be dug, if possible, with almost perpendicular sides, or sloping inward from the top on the side to be protected, so that the caterpillars cannot readily crawl out. When the ditches are filled with the struggling caterpillars, if dry straw is scattered over them and fire applied it will kill them and clear the ditch for another lot.

The corn worm of Maryland, or boll-worm of the South, *Heliothis armigera*, Hüb., (Agricultural Report, 1854,) has been found to be very injurious, not only to cotton and maize, but also to green peas, pumpkins, and, last year especially, to both the ripe and unripe fruit of the tomato, into which the caterpillar bores, rendering it totally unfit for use. A single caterpillar will sometimes entirely ruin a number of the fruit on one plant alone. Plates or wide-mouthed bottles of sirup or sweetened vinegar placed near the vines will attract the moths in the evening twilight, and in the morning many dead millers will be found stuck fast in the viscid substance.

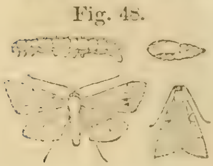
The larva of *Phakellura nitidalis*, Cramer, or cucumber moth, was taken several years ago in Florida boring holes in the fruit of the squash and feeding on the flesh inside. Last year the larva of this insect was reported as very injurious to melons and cucumbers in Missouri, by eating holes in the fruit, from July to the end of September, as many as four being sometimes found in one cucumber. The pupæ are formed in slight cocoons of white silk on leaves near the ground, and the perfect moth appears in eight to ten days and probably hybernates as a perfect insect. This larva is said also by Guené to feed on potatoes. To destroy this pest it has been recommended to examine the cucumbers and melons early in the season, and to destroy the first worms that appear and also all infested fruit. The upper wings of the moth are of a yellowish-brown color, with a semi-transparent, irregular, yellow spot, while the hind wings are of the same semi-transparent yellow color, with a broad dark border.

Fig. 47.



The clover-worm, or gold-fringe moth, *Asopia costalis*, Led., was found so plentiful in a stack of clover and hay, in Maryland, that the place literally swarmed with them, and the hay appeared to be totally ruined. The larva attacks and spoils clover for feeding purposes, both in the stack and by interweaving and covering it with silken webs and black excrement that much resembles gunpowder. It has been stated that they feed on dried clover alone, but some experimented with fed sparingly

Fig. 48.



on the fresh flowers, rejecting both leaves and stalks. The pupa is formed in a slight cocoon, and the moths fly late in June and July. The colors of the perfect insect are reddish-brown with yellow markings, and broad, golden-like fringes to the wings.

The canker-worm of the Northeastern States, *Anisopteryx vernata*, (Peck,) is said to have made its appearance in Michigan in apple orchards, and, if true, may be expected to spread rapidly if not checked in time. The eggs are deposited to the number of sixty to one hundred, in rows, glued to the surface of the bark, and the larvæ, as soon as hatched, destroy the foliage. The pupæ are formed two to six inches under ground, in rude earthen cocoons, beneath the trees, and the perfect female, late in the autumn or early in the spring, crawls up the trunk of the tree (as she is wingless) to deposit her eggs, which hatch out in the spring into small looping caterpillars, or so-called measuring-worms, and in a short time destroy all the foliage. The remedy to be sought, therefore, is something that will prevent the wingless female from ascending the tree to lay her eggs. Leaden oil-troughs have been used with some success, but if they are used around the trunk itself, the oil running over is apt to injure the tree, and it might be safer to form a tight inclosure of boards, or a box a foot or more in height, the same as that recommended for the elm-tree beetles; only in this instance the tin projection, coated with some viscid substance, should be on the outer sides of the box, or the oil-troughs themselves could be placed around the box on the outside, at some distance from the tin projection. This would save any risk of injury to the trunk by leakage or spilling of the oil. The tin would also protect the oil from being washed out by heavy rains, and at the same time be a second almost impassable barrier to the progress of such insects as might be enabled accidentally to cross the trough of oil. Muriate of lime is said to be useless in destroying these insects. Late fall plowing and the use of hogs are highly recommended. A good jarring when the worms are on the tree will shake most of them from the branches to the ground. Some, however, will remain suspended in the air by a silken thread, which can be easily severed by swinging a stick. When all the worms are on the ground they may be destroyed by scattering straw over them and setting fire to it, taking care not to injure the tree itself.

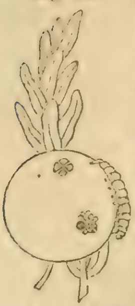
Fig. 49.

The cranberry crops in various parts of New Jersey and the New England States have been very much injured by the attacks of the larvæ of a small *Tortrix* or moth, *Anchylopera vaccineana*, (Packard's Guide,) commonly called the cranberry or fire-worm. The eggs of this insect remain all winter on the plants, hatching from the 20th of May to the 1st of June. The caterpillars feed on the tender-growing shoots, drawing the leaves together with their webs for shelter, and, concealing themselves within, they feed upon the foliage. They reach their full size in about two weeks, when they spin up in a light cocoon among the leaves or rubbish on the ground. The pupa state lasts ten to twelve days, and the moths are numerous (in Massachusetts) from June 10 to July 1. A second crop of eggs is laid in August and September, which remain on the plant all winter.

Fig. 50.

Another caterpillar appears about August 1, (in Massachusetts,) and injures the fruit, the berries that are attacked turning prematurely red, which is the first indication of their presence. Most of the larvæ reach their full size before September, and, when fully grown, enter the ground, spinning their cocoons within a few inches of the surface. These cocoons are covered with sand, and are hardly distinguishable from small lumps of earth. Several caterpillars sent from New Jersey, as injuring the fruit of the cranberry, resembled in habits the above insect, excepting the cocoons were formed on the surface of the earth, but unfortunately I was not able to raise one perfect moth. The only remedy recommended is to flood the infested patches, when practicable, until the worms are destroyed.

Fig. 51.

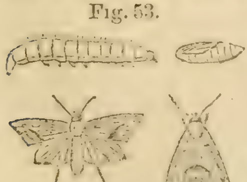


A small caterpillar, the grape-berry moth, *Lobesia botrana*, (Zeller,) (*Penthina vitivorana* of Riley,) was found in large numbers during the last season infesting the grape in Maryland. The larvæ of the first brood are stated by some entomologists to feed upon the leaves, which they roll up, but this is denied by others. At least when the grapes are formed the larva bores into them and feeds upon the pulp. When it reaches the seeds it eats out the interior, and if one grape is not sufficient, it fastens the already ruined grape to an adjoining one by means of silken threads, and burrows into it likewise. Mr. Riley states that the cocoons are formed on the leaves by cutting out a clean, oval flap, leaving it hinged on one side, rolling it over, and fastening it to the leaf; but those found in Maryland spun loose cocoons amidst the grapes and leaves, or on the surface of the ground. There are probably two or three broods in one season, and the last brood passes the winter within the cocoon either as larvæ or pupæ. A little attention given to the grape-vines early in the season, by pulling off all infested grapes and destroying them, will be of great utility, as it was observed, in the experiments made, that, after the first crop of larvæ had been carefully taken off the vines to study their habits, later in the season, scarcely a single spotted or infested grape could be found on the same vine, with which to continue the experiments.

Fig. 52.

The well-known apple codling-moth, *Carpocapsa pomonella*, (Linn.) has been extremely destructive to the apple crop in general by burrowing out and destroying the fruit. Many fruit-growers have come to the conclusion that keeping hogs in the orchards to devour the fallen fruit is the best and surest remedy for this insect as well as the plum curculio. Hay bands or ropes around the trunk and principal limbs of the trees have been recommended, as they furnish a shelter under which the caterpillars will seek refuge when about to form their cocoons. Here they can easily be found, and destroyed by rubbing the band briskly up and down every four or five days, so as to crush the insects harboring under it. Other orchardists, however, recommend rags and softer substances, to be placed in the crotches of the branches or around the trunks, &c., as they can be taken off and more readily examined for insects than the hay ropes.

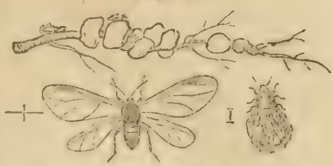
Fig. 53.



The apple-root plant-louse, *Eriosoma (Pemphigus) pyri*, (Fitch,) forming wart-like excrescences upon the roots of the apple trees, which contain in their crevices the insects which suck their juices, is said to be de-

stroyed by an application of boiling-hot water. The editor of the American Entomologist remarks, however, that in transplanting young trees from the nurseries, it is not necessary to have the water too near the boiling point, and that a heat of 120° to 150° will suffice. The horticultural editor of the Prairie Farmer doubting the hot-water remedy, Mr. Riley states that this doubt will hold good in reference to large, deep-rooted trees, but that he knows from experience that hot water can be used against these root-lice in the nursery, where the greater damage is done. Hot water has also been recommended to be placed around the trunks of such peach trees in the winter as are infested by the peach-borer, (*Ægeria exitiosa*, Say.)

Fig. 54.



To destroy common plant lice (*Aphides*) and other insects in the green-house and garden, the following remedy has been recommended by M. Cloetz, of the Jardin des Plantes, in Paris: Three and one-half ounces quassia chips, five drams of stavesacre seeds,* powdered and placed in seven pints of water, and boiled until reduced to five pints.

Dr. Hull recommends dusting slacked lime on the trees or bushes when the foliage is wet; syringing with soap-suds or tobacco water, or a strong decoction of quassia with soap-suds; also, a weak solution of chloride of lime is said by Mr. Andrews to preserve plants from insects if sprinkled over them. The following recipe is also highly recommended in an English horticultural journal as being almost infallible "for mildew, scale, mealy bug, red spider, and thrips:" Two ounces flour of sulphur worked into a paste with water, two ounces washing soda, one-half ounce common shag tobacco, and a piece of quicklime about the size of a duck's egg. Pour them all into a saucepan with one gallon of water, boil and stir for a quarter of an hour, and let the whole settle until it becomes cold and clear. It should then be poured off, leaving the sediment. In using it, add water according to the strength or substance of the foliage. It will keep good for a long time if kept closed.

A question of considerable interest has arisen during the past year among the vine-growers of France as to whether the disease known by the name of *pourridie*, or rotting, which is in the form of little cankerous spots, cutting off the supply of nourishment, and causing the roots of the vine to rot, produced by a species of root-louse belonging to the coccus family, and named by Plancheron *Phylloxera vastatrix*, is not a different form of another insect which produces the bag-like galls on some of our native North American grape-vine leaves, namely, the *Pemphigus* (*Dactylosphæra*, Shimer) *vitifoliæ* of Fitch. This insect appears early in June in New York, and forms small globular galls the size of a pea, which grow on the under-side of the leaves, having a somewhat uneven and woolly surface, with a cavity inside. Mr. Riley, of the American Agriculturist, however, who has made a specialty of this subject, states that in Missouri this insect has proved very injurious to the Clinton grape-vine for several years past, at least as far back as 1864, and gives a graphic description of its natural history and habits, as follows:

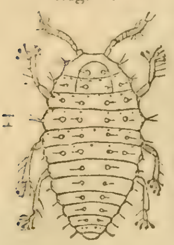
A few females, in the spring, station themselves upon the upper sides of the leaf, and by constant suction and irritation cause the leaf to swell irregularly on the under side, while the upper part of the leaf gradually becomes fuzzy and closes, so that the louse at last sinks from view in the cavity of the so-called gall, in the interior of which she

---

* A plant of the genus *Delphinium* or larkspur, *D. staphisagria*, the seeds of which are narcotic and stimulating, and are used for destroying vermin.

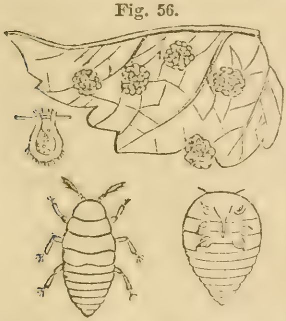
deposits from fifty to four hundred or five hundred small yellow eggs. When hatched the insects escape from the gall through an orifice in the upper side of the leaf, which was never entirely closed, and, taking up their abode on the young and tender leaves, in their turn form new galls. Sometimes one to four mother lice are found in a single gall. The galls generally appear about May or June, and are commonly found most abundant on the Clinton and Taylor varieties of the frost grape, (*Vitis cordifolia*,) and not on the Catawba, Isabella, and Concord, which are derived from our wild *Vitis labrusca*. When the mother louse has deposited all her eggs in the so-called gall, she dies, and the excrescence dries up. This goes on all the season until autumn, and the vine having finished its growth, the young lice, finding no more succulent leaves, begin to wander and to seek the roots, so that by the end of September the galls are deserted, and the lice, attaching themselves to the roots, either singly or in little groups, cause by their punctures little swellings and knots, which eventually become rotten. The lice, also, change their appearance under ground, shedding their skins, and, instead of presenting a smooth appearance, becomes tubercled, and the insect passes the winter in the tubercled state; but whether in the spring these tubercled individuals produce winged males and females which rise in the air, pair, and, by depositing eggs, give birth to apterous females which form the gall-producing colonies, or whether they lay eggs on the roots, the young from which crawl up to the leaves to found gall-producing colonies, is not positively known.

Fig. 55.



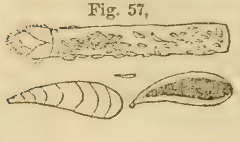
Dr. Shimer, however, states that he has seen four-winged insects in the autumn in galls destroyed by parasites. Mr. Riley, in proof of the theory that *Phylloxera vastatrix*, (Planch.) and *Pemphigus vitifoliæ*, of Fitch, are one and the same insect, in different forms, having different habits, states that he has proved by transferring to roots the young grape-lice hatched from galls, and by successfully feeding them on those roots, that one smooth gall-inhabiting type gives birth to the tubercled root-inhabiting type: and, also, that our gall insects (*Pemphigus vitifoliæ*, Fitch,) take the root in the fall, on which they cause the same cankerous spots and swellings as does the *P. vastatrix* of Europe, and on which they evidently hybernate, just as *P. vastatrix* is known to do. Several years ago I found the gall-inhabiting insect in Iowa on a wild grape, and since then, in Maryland, on cultivated species. Last year several specimens of the gall-infested leaves were sent to the Department from a Clinton vine, and, although the roots were examined some time afterward, no trace of any of the root-inhabiting species could be discovered. The remedies proposed for the root-louse are carbolic acid, sulphuret of lime dissolved in water, and an oil known among veterinary surgeons as "oil of cade," dissolved in water. These were found the best specifics, but none of them have been tried on an extensive scale. Perhaps an application of hot water, as recommended for the apple root-louse might answer, if the ground were cleared away in winter from the roots, and the water not too hot to injure the plants. As for the gall insects, great care should be taken to gather all the gall-infested leaves when they make their first appearance, and to burn them immediately, so that none escape to found the root-injuring colonies in the fall and winter.

Fig. 56.



The apple or oyster-shell bark-louse, *Aspidiotus conchiformis*, (Gmelin,) having oblong, flattish, brown scales, with white eggs, and the native apple bark-louse, *Aspidiotus Harrisii*, (Walsh,) of which the scale is oval, almost flat, and of a pure white color, with red eggs, may be destroyed when the young are hatching out of

Fig. 57,

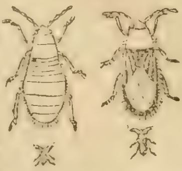


the eggs in May and June, by washing the trunks and branches of infested trees with two parts of soft soap to eight parts of water, adding lime enough to give it the consistence of whitewash; or thoroughly syringing with strong tobacco-water and soap-suds.

Fig. 58.

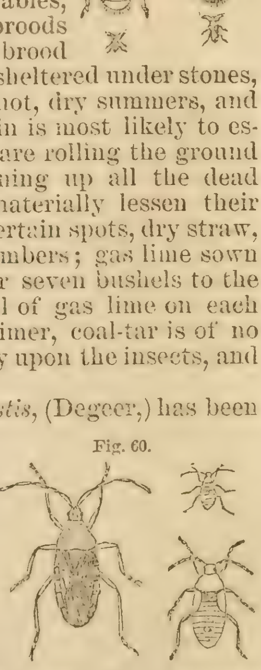
The eggs of the chinch-bug, *Rhyparochromus* (*Micropus*) *leucopterus*, (Say,) an insect which has done great damage to grain in certain localities, are deposited in the ground to the number of about five hundred by one female. The young larvæ are hatched under the earth, having been found in great numbers at a depth of an inch or more, and are at first wingless, and of a bright red color. They puncture, and apparently poison, in both larva and pupa as well as perfect states, the terminal shoots, buds, and the most succulent parts of growing plants of grain, grass, maize, potatoes, and other vegetables, but do not attack woody plants. There are two broods annually and perhaps three in the south, the last brood hybernating in the perfect state under leaves, or sheltered under stones, earth, &c. The insects are most destructive in hot, dry summers, and heavy rains are said to destroy them. Early grain is most likely to escape their ravages. The remedies recommended are rolling the ground where the young insects are, if practicable; burning up all the dead vegetation and dry rubbish along fences will materially lessen their numbers the next season; when congregated on certain spots, dry straw, spread over the place and burned, will destroy numbers; gas lime sown broadcast over infested fields, at the rate of six or seven bushels to the acre, is also recommended; or dropping a handful of gas lime on each hill of corn, when infested. According to Dr. Shimer, coal-tar is of no use as a remedy. Quails are said to feed greedily upon the insects, and should therefore be protected.

Fig. 59.



The common squash bug, *Coreus* (*Gonocerus*) *tristis*, (Degeer,) has been extremely injurious to the squash family in many parts of the Middle States, injuring the plants in larva, pupa, and perfect states, by congregating in great numbers around the stem near the ground, or on the leaves, and sucking out the sap by means of their strong beaks. The eggs of this insect are deposited in little patches fastened to the under-side of the leaves in June and July. It is stated, however, that all the eggs are not deposited at the same time. The young insects live in families, puncturing the leaves and stem, and draining the sap from the plant. The perfect insects hybernate in crevices of walls and fences, and have been found in Maryland in midwinter under the bark of rotting trees, from whence they come out in summer to deposit their eggs for the first generation. One of the remedies recommended is to remove all the earth from the roots as far as they will bear, and fill up with a mixture of dry ashes and salt, which will prevent the insects from burrowing near the root. Another remedy is to trim off the under leaves early in the season, laying them in the evening under and close to the plant; the insects hiding under them can be found and destroyed in the morning. It has been suggested to lay pieces of boards along the rows, a little raised from the ground by small stones. During the night the insects will congregate under the trap; the boards and leaves, however, should be examined very early in the morning,

Fig. 60.



for as soon as warmed by the sun the insects will disperse over the vines.

The harlequin cabbage-bug, *Strachia histrionycha*, (Hahn.,) mentioned three years ago, (Agricultural Report, 1867, page 71,) has been much complained of during the past year as doing great damage to the cabbage in North Carolina and elsewhere. The perfect insect hybernates in sheltered places, and the female deposits her eggs in March and April, in two rows, cemented together, mostly on the under-side of the leaf, and generally ten to twelve in number. In about six days the first broods make their appearance, the young larvæ resembling the perfect insect, with the exception of being wingless. About sixteen to eighteen days elapse from the deposition of the eggs to the development of the perfect insect. A second brood appears in July, which probably hybernates (in North Carolina) in sheltered places. It is said that fowls and birds will not eat them, and the only remedy recommended is handpicking, and, as stated in my report for 1867, "as they hybernate in the perfect state beneath bark, under brush heaps or stones, like the cotton red-bug, it would be well in winter to search for them in such situations, and in spring to destroy them on their first appearance upon the plants, before they have had time to deposit their eggs;" or if little heaps of rotting vegetables were left as places of shelter, here and there during the winter, so that they might be induced to hybernate under them, they might readily be destroyed in spring by burning straw over the heaps.

In conclusion, the utility of enacting laws in the different States and counties for the preservation of the various insectivorous birds cannot be too highly recommended, as birds are no doubt one of the great agents specially designed by Providence to keep in check the myriads of insects which would, if left undisturbed, increase so rapidly as to totally destroy certain kinds of vegetation. The English house sparrows, recently introduced into some of our seaboard cities, have become entirely acclimated, and have increased rapidly, and it is universally acknowledged that where they exist in any numbers the caterpillars, which were formerly such an annoyance to pedestrians, have almost entirely disappeared. There is little doubt that sparrows will also eat certain grains and small fruits whenever they can find them readily; but, as these birds reside in the cities mostly, this is not of much consequence, especially as, should they increase too rapidly and migrate into the wheat fields so as to become a nuisance, a few birds may much more readily be destroyed by shot or traps than the myriads of insects, which would lie safely hidden amidst the dense foliage of the shade trees, or in the crevices of the bark, where the hands of man cannot reach without much labor and trouble. An English paper states that out of one hundred and eighteen sparrows killed for the sake of testing the amount of benefit or injury done by them, only three were found to have been living the preceding twenty-four hours on grain; beetles, grubs, and larvæ having been their diet. Out of seventy-five sparrows of all ages, there were hardly any without insect remains in them. It is somewhat singular that among the multitudes of sparrows and other birds imported, we have heard of only one or two instances where the robin-redbreast of Europe has been introduced into the public parks. This bird is not only insectivorous, but is also everywhere noted for its familiar habits and the sweetness of its song. Toads in gardens are great insect destroyers, and are ever busy at dusk or early in the morning searching for insect prey. Instances have this past year been chronicled of their eating even the acrid potato cantharis (*Lytta*

vittata, &c.) and the nauseous-smelling squash-bug. In short, it may be plainly stated that without the coöperation of certain birds, animals, &c., this country would be overrun with insect pests; and it has been found that in most cases wherever certain birds have been destroyed as injurious to some of the crops, the farmers have been overrun with grub-worms, wire-worms, &c., for years afterward, and have only been too glad to import again the very same species of birds for which they once paid so much per head to have destroyed.

TOWNEND GLOVER,
Entomologist and Curator of the Museum.

Hon. HORACE CAPRON,
Commissioner.

REPORT OF THE CHEMIST.

SIR: The work of the laboratory during the year 1869-'70 has been mainly of the same nature as during the preceding year. The efforts to lessen the number of analyses of an unimportant nature in their bearing upon agricultural science, have been so far successful that the number accepted and performed has, for the first time, been within the means of the laboratory to complete; and the new year opened with no work remaining on hand except the general investigations which will extend at least over the ensuing year. This fact affords ground for the hope that the time is not far distant when all the efforts of the laboratory may be directed toward questions of vital and general importance.

The analyses performed include a large number of mineral determinations, undertaken at the instance both of scientific men and explorers; assays of ores of the precious and other metals; analyses of soils, among which will be mentioned the alkaline soils from Nevada; marls, guano, marsh mud, peat, saline matters from the plains, artificial and natural fertilizers, not included in the above; wines, grapes; investigations made at the request of different States; proximate analyses of plants; cases of suspected poisoning, both of human beings and animals; Indian food materials; meat extracts; mineral waters; residues from the same; refuse from several manufactures; and lastly the answering of a large number of letters of inquiry from farmers, brewers, and other sources, upon questions touching the industrial arts and manufactures connected with agriculture. This correspondence involves great labor, and the expenditure of much time. It requires a certain and extended acquaintance with the status of these arts at the present day, for which acquaintance much time is expended which would otherwise be bestowed on matters strictly connected with the laboratory. This function of the chemical division, although a severe tax upon it, is both beneficial to the farmer, and may be considered as but the discharge of a just debt incurred by the Department in obtaining, as it does, through its statistical division, invaluable information from the people.

Besides the work already enumerated, the important investigation of the cereal crops which has been alluded to in the report for 1868, has been commenced. There have already been collected from various parts of the United States above seven hundred and fifty specimens, derived from over two hundred localities, of corn, wheat, rye, and oats, representing average crops in the several States and Territories, and raised under conditions so vastly different as regards climate, elevation,

and soil, that the results of their examination may naturally be expected to lead to some insight into the effect of such conditions upon vegetable growth and nutritive value.

For the careful and uninterrupted conduct of these inquiries it was found necessary during the year to fit up a small laboratory to be specially devoted to this object, and which has been made as complete as the limited appropriation would allow. The services of an additional assistant have been secured to commence the work, who has been occupied since September last with the necessary preparations for so large an undertaking. Those who are engaged in the examination of vegetable substances by proximate analysis know how unsatisfactory and conflicting even the best systems adopted by the most eminent chemists are, and how imperfectly the present knowledge and chemical literature afford guides for the rapid and accurate performance of this, probably the most extensive work of the kind ever attempted. Even the most accurate researches made upon plants in German schools, and to be found only in certain European journals, show us the incomplete and unsatisfactory condition in which proximate analysis stands at this time. The most recent examinations made upon cereals, either in this country or abroad, leave very much to be desired both as regards exactness and comprehensiveness. As an illustration, the methods for the determination of starch, gum, cellulose, &c., are exceedingly unsatisfactory and inexact, partly owing to the adoption of imperfect processes, and partly to the assuming of the proportions of some "by difference," results from which modes disfigure even the most recent investigations.

A portion of the time of the assistant detailed for this work has been expended in the experimental comparison of various processes used in some of these determinations, with the view of arriving at results from which a general scheme of work may be deduced.

Among the analytical work done in the laboratory, some few instances are found possessing a general interest. I therefore select them for such remark as seems indicated, leaving the mass of our work in this direction without further detailing it.

ARACHIS HYPOGEA—GROUND NUT—PEANUT.

Mr. Thomas S. Pleasants, of Petersburg, Virginia, in a paper on the diversity of vegetable productions—reference being chiefly made to their suitability for that State—published in the Annual Report of this Department for 1867, has called attention to the value of this plant as an article of food suitable for cultivation in the southern counties of Virginia, and states (p. 252) that under careful and judicious management it will yield fifty or sixty, or from that to eighty bushels, per acre, worth from $1 50 to $2 50 per bushel. The market price at this time is $2 25. As there are many portions of other States equally favorably situated for the growth of this plant, and as many applications have been made to the Department to ascertain what mineral elements were necessary for its successful growth, an analysis of the husk and nut was made, with the following result:

1. Husk and nut in 100 parts—

Water	2.60
Albuminous and fibrous matters and starch	79.26
Oil	16.00
Ash	2.00
Loss	0.14
	100.00

2. Husk and seed separately:

	Seed.	Husk.
Moisture	2.51	2.61
Albuminous matters and farina	79.71	trace.
Cellulose	......	85.48
Ash	1.77	11.90
Oil	16.00	......
	100.00	100.00

The weight of the husk is to that of the seed as 1:16. The ash of the seed consists of salts wholly soluble in water, they being phosphates of the alkalies, with traces of alkaline chlorides and sulphates. The phosphoric acid is chiefly united with potassa. The ash of the husk differs in containing chiefly common salt, and phosphates of lime and magnesia. The amount of oil which the nut contains is very large; it varies according to latitude and other favorable conditions; and in the south of France and other countries of Mediterranean Europe the seeds are pressed to obtain the oil, which is applied to table use. The *marc*, or pressed cake, is used both as food for cattle—in which it resembles linseed cake—and also is exported to Great Britain for use as a manure. If any surplus remains after sending the nut to market, it might be used as winter food for cattle. As the whole of the oil and albumen lie in the nut and not in the husk, there is little nutritive material in the latter. The most of the French cake is derived from seed grown in Algiers, where the plants flourish vigorously, and afford much more oil than those grown in this country. It is possible that the farther south the nut is grown the more oil will be developed in the seed. The Algerian growth furnishes 25 to 27 per cent., and the ash of the cake as analyzed by Dr. Anderson, of Edinburgh, amounted to 1.25 per cent; the nitrogen of the cake amounted to 5.39 per cent. As the quantity of oil in the Virginia growth is less than in that of Algiers, the percentage of albuminous material is higher, and probably amounts to a little over one-third of the whole product, which would bring the nitrogen element up to 6 per cent.

The result of an analysis of the cake, or *marc*, of the *Arachis hypogea* is given in the Transactions of the Highland and Agricultural Society of Scotland, vol. 6, p. 556. (Edinburgh, 1855.) The sample was forwarded from Bordeaux to Edinburgh, and the analysis made by Dr. Anderson; a second sample imported into Leith was also examined. The composition of both is given here:

		Bordeaux.	Leith.
Water		11.56	10.01
Oil		12.75	6.78
Albuminous compounds		26.71	33.85
Ash		3.29	3.78
Fiber		45.00	45.58
Total		100.00	100.00
Nitrogen		4.27	5.39
Ash contains	Phosphates	1.17	1.14
	Phosphoric acid	0.08	0.52

As the ash consists almost wholly of soluble phosphates, (phosphates of soda and of ammonia,) with a small amount of common salt, the most useful artificial manure which can be used for it is one which contains the materials of a superphosphate, or one already made—bones in pow-

der, fermented with wood ashes, (unleached,) or the prepared superphosphates made in the market, or by the farmer himself.

SUGAR-HOUSE REFUSE.

A sample of this material, sent by Dr. William S. Robinson, of Hatborough, Montgomery County, Pennsylvania, contained, by analysis:

Water	8.03
*Organic matter	71.28
Phosphate of lime	5.09
Sulphate of lime	7.51
Silica, (insoluble)	5.09
Alumina, oxide of iron, and small amounts of alkaline salts	3.00
	100.00

The mass consists of the waste of sugar while being filtered, and besides the uncrystallizable debris it contains some of the materials of the filters and the clarifiers. It is a material much used as a manure by the farmers of the vicinity of Philadelphia. From six to seven tons are applied to the acre, and good crops of grain or grass result. The mineral ingredients are useful, though in small amount, and the organic matter is largely of a soluble nature, yielding also a small amount of nitrogen. Being of a gummy and saccharine nature it is much less valuable as manure than a similar amount of fibrous vegetable matter. But as its cost is very low, (less than $2 per ton,) it is a valuable ingredient for a compost, to be made within a small distance from the supply.

Sugar-house waste is generally stated to be the waste bone-black of the sugar-refining process, accompanied by the impurities and scum of the sugar while in the fluid condition. Whatever materials may have been used in the process of refining will, of course, be found in waste, such as blood, glue, size, plaster, or powdered quick-lime. It is stated that it often contains from one-fifth to one-fourth of its weight of blood, and is therefore considered from four to six times more powerful than animal charcoal alone. Where these matters are abundant the proportion of carbonized bone-ash must be correspondingly deficient, and hence it is that the material may have very different compositions and values. In Browne's Field Book of Manures, New York, 1856, two analyses of the refuse are given, and are here appended:

	No. 1.	No. 2.
Charcoal	34	12
Phosphates, and carbonates of lime and magnesia	62.25	65
Sugar, and organic coloring matter, with isinglass	2.35	10
Water	1.40	13
	100.00	100

In these the bone-black is the most abundant ingredient, and the value of the article depends on the phosphate of lime it contains; but in the samples from the refinery, at Philadelphia, the bone-earth is the least ingredient, and the phosphate of lime is small in amount. The blood element also is small, as is shown by the small percentage of nitrogen which it affords. It is chiefly composed of unburned bone, charcoal, with a large amount of waste organic matter, and uncrystallizable sugar, and it cannot make a valuable material for composting with other substances, either animal or vegetable, to form a valuable and expensive manure.

* Containing nitrogen 1.355 per cent. = 1.63 per cent. of ammonia.

RESIDUE FROM ALUM SPRINGS.

A sample of residue from the boiling down of the water of a mineral spring in the neighborhood of Abingdon, Virginia, forwarded by Mr. Jacob Rodefer, yielded, on examination:

Sulphate of lime	22.61
Sulphate of soda	6.89
Sulphate of alumina } Sulphate of iron }	22.11
Sulphate of magnesia	6.91
Sand	6.78
Soluble silica	0.94
Organic matter	traces.
Moisture and combined water	33.76
	100 00

Water of this and other springs of the vicinity is much in demand, and the mass obtained by drying down the water in kettles is called "alum mass." It is a dry powder, neither efflorescent nor deliquescent, and of a strong and unpleasant styptic taste. It is sold by the ounce to those at a distance from the springs. The sources of these waters evidently have a close connection with the beds of gypsum and rock-salt about eighteen miles distant from the court-house.

COAL.

Sample from Palafox Grant, on the Rio Grande, thirty miles above Lorado, Webb County, Texas; approximate analysis:

Specific gravity, 1.333

Water, (at 140° C)	2.53
Volatile combined matter, driven off in a closed vessel at a red heat	38.81
Fixed carbon	45.10
Ash	13.56
	100.00
Coke	58.66

Ash, white, slightly acid; coke, friable.

This coal has no caking property, and is distinctly lamellar. In chemical constitution it is analogous to the Virginian free-burning coal described by Professor W. Johnson in his report on coal, (made to Congress, 1844.) It is brittle, laminated, and has an imperfect conchoidal fracture.

GYPSUM.

A sample of gypsum rock from Smythe County, Virginia, forwarded by Hon. John W. Johnston, yielded, in 100 parts:

Moisture, (hygroscopic)	6.63
Organic matter and water of combination	13.50
Sulphate of lime	62.417
Carbonate of lime	1.363
Magnesia	trace.
Alumina, oxide of iron, and traces of alkaline chlorides	11.02
Sand	5.07
	100.000

It is a semi-crystalline rock, banded like gneiss, with layers of pure acicular prisms of sulphate of lime, from one-third to one-half inch thick, which are separated by bands of gray amorphous, aluminous rock. This gypsum burns very white, and appears to be well adapted for all the

purposes to which it is generally applied. The above constitution shows it to contain 75 per cent. of pure crystalline gypsum, 6 per cent. of interstitial water, and 18 per cent. of impurities.

Dr. Edward Palmer brought to the laboratory from Western Kansas prairies a sample of what is called "alkali" of the western plains. It was in the form of a dry, milk-white powder, mixed with bleached leaves and coarse grass. It did not effervesce with acids, nor did it exhibit an acid reaction to test-paper. It contained:

Water	3.6
Insoluble clay	1.5
Chloride of sodium	traces.
Sulphate of soda	94.6
	99.7

It is consequently a native sulphate of soda, which, from the small amount of water present, may be classed as anhydrous. There is no evidence to show that it is a product of volcanic action. It differs from the varieties of mirabilite of Dana in the small amount of water, which we may conjecture has been lost during the prolonged heat of summer. It may owe its origin to the decomposition of sulphate of lime, which is so largely present in the soils at the foot of the Rocky Mountains and Sierra Nevada series, by means of carbonate of soda occurring as efflorescences on soil. The usual origin of sulphate of soda is either directly from volcanic sources, or by the delivery of springs containing the salt derived from preëxisting sedimentary beds. In a few cases it is derived from the oxidation of sulphur in bituminous strata, or in pyritiferous beds, which, reacting on common salt, produces thenardite or other forms of sodic sulphate.

MARLS—THEIR USE AND INFLUENCE.

There is no class of substances which is more frequently examined in this laboratory than the marls found in the several States. Hundreds of them are constantly being forwarded. It would be unnecessary to swell the report with returns of their composition, although to the different States there could be no contribution of greater value to their agriculture than a thorough examination and report upon the extended marl beds, mineral deposits, and sources of lime for agriculture. Science now no longer looks on marls and similar deposits as merely such a weight of earthy materials, composed of a certain number of hundred-weight of sand, or so many pounds of lime, magnesia, and oxide of iron, added to the soil to directly increase the amounts of these substances; but also as composed of substances possessing physical properties and chemical affinities whereby they react upon the farm-yard and other manures, when brought into contact with them, and become detainers for a more or less lengthened period of some of the richer portions of the compost heap, and prevent their removal from or loss to the soil by the washing influence of rains. If this did not occur we should never find ready formed ammonia and nitric acid in all fertile soils, and soluble chlorides and sulphates which are afterward found in the ashes of plants. The experiments of Professor Way are well known, in which he proved the power of soils to absorb and retain mineral matters in solution, and to deprive a solution of a certain percentage of its saline matters. In passing a solution of ammonia through several soils, he found that all soils had the power of retaining a portion of that body, some more and some less. He also observed that lime, magnesia, potash,

and phosphoric acid were absorbed by all soils to a considerable extent. Way also showed that cultivated soils not only absorb free alkalies and acids, but have likewise the power of separating ammonia, potash, and other bases from preëxisting combinations. He operated on single solutions, and it might be objected that no inference could be safely drawn as to what an actual soil might do if the conditions were varied, so that, instead of one solution, several, or a mixture of several salts dissolved, were to be presented to that soil; and as this is what actually occurs, it became necessary to interrogate nature by experiment on this point. Voelcker's experiments on the action of soils on liquid manure, and on sewage percolated through them, showed how very inferior sandy soils were to calcareous clay soils in their power of retaining ammonia and potash. If the manure added contained any lime, much more of it was removed by the sandy soil than by the clay; and as regards common salt, there seemed no special attraction exerted by any soil, howsoever different might be its composition, the chloride of sodium diffusing itself out from every soil in the rainfall. From these and similar experiments, it is rendered evident that there is an inherent power in soils which results in storing up mineral food, and that this power is not confined to one particular kind of fertilizing matter, but applies to them all, and is exhibited in a manner modified by the special constitution of the soil. Another very important fact deducible from Voelcker's experiment is, that this absorbing and detaining power of soils is not exerted on very weak solutions. Neither the ammonia, potash, phosphoric acid, nor other fertilizing matter contained in a solution, were ever *completely* absorbed by any soil, however weak or concentrated the solutions were which were filtered through the soil. "Indeed," says Voelcker, "if the solution of saline matter brought into contact with the soil be very dilute, scarcely any absorption of ammonia, potash, or phosphoric acid takes place." This latter statement is very important, as it shows that sewage of towns is of no value when very dilute, (and it is almost always too dilute,) since the soil, though possessing highly absorbent powers, has not the power of overcoming the affinity of the water of the solution, and hence it withdraws none of the fertilizing matter of the sewage. One of the uses of calcareous marls, therefore, upon sandy or pure clay soils, is to increase the power of such a soil to absorb ammonia and potash. Carbonate of lime absorbs six times as much ammoniacal salt as stiff clay. If it were not for this retentive power, carbonate of ammonia, when present in the soil and carried down by the moisture in the wet season, would, when the season is dry and the solar heat strong, be carried to the surface of the soil and evaporated at once. It is in this way that gypsum (sulphate of lime) acts, hindering by its presence the dispersion of the greater part of the ammonia. These soluble substances are constantly rising and falling in the soil, according as it is wet or dry, cold or heated. These matters descend during rain or in winter, and rise during the warmth of summer, when the evaporation is greatest and when the plants need more moisture and food. The ascension of these matters varies thus every month, and thus the analysis of a soil at one period of the year does not exactly represent its composition at another; it is variable at different times, and, therefore, no exact idea of the chemical or physical properties of a soil can be obtained by a single analysis, no matter how accurately conducted.

Marl and muck from Jacksonville, Florida.

	Marl.	Muck.
Water	1.27	41.80
Organic matter	2.40	27.10
Carbonate of lime	87.39	Ash, 31.10
Alumina and oxide of iron	8.00	
Phosphoric acid	Traces.	
Sulphuric acid	0.50	
	99.56	100.00

These are worthy of notice on account of their essential dissimilarity. The marl is derived from the great source of the limes of the State, the underlying coral beds, and contains but little vegetable matter, while what is termed muck is almost equally composed of earthy and vegetable matter. The mixture of the marl and muck together would improve both.

Marl, marsh mud, &c.

	Marl.	Marsh mud.		
		No. 1.	No. 2.	No. 3.
Water	1.04	1.91	1.25	2.04
Organic matter	1.90	10.46	9.77	14.02
Silica and insoluble silicates	38.21	72.08	72.30	....
Sand, &c	....	....	....	67.80
Alumina and oxide of iron	1.35	13.36	10.43	6.21
Lime	29.80	1.30	2.71	....
Lime, (sulphate)	....	....	....	3.93
Carbonic acid	22.35	Trace.	0.93	....
Sulphuric acid	1.93	Trace.	0.98	....
Phosphoric acid	0.03	Trace.	Trace.	....
Chloride of sodium	0.39	0.89	1.63	4.48
Chloride of potassium	Trace.	....	Trace.	1.52
	100.00	100.00	100.00	100.00

The marl and Nos. 1 and 2 of the mud were from Savannah, Georgia. The last (No. 3) from "Burnside's Island." Nos. 1 and 2 show the influence of brackish water in the unusual quantity of alkaline chloride present. No. 3 shows the influence of sea-water in the unusual amount of these chlorides, especially the sodic chloride, and its abundance implies that there is no outlet or drain in that marsh.

BEET SUGAR.

It is remarkable that as yet the returns of the growth of sugar beet in this country have not shown an approach to that amount of sugar which is yielded by the growth of France and Northern Germany. The Department has received several letters from various beet cultivators, reciting the results of their efforts in growing seed of the varieties obtained from Vilmorin & Company, of Paris. In the cultivation of a plant whose juice contains not merely sugar, but many other substances, which undergo decomposition or suffer change of constitution as the plant matures, it is difficult to determine at what period the proportion of sugar

is in greatest amount relatively to the other organic matters, which latter may so interfere with the separation and crystallizing of the sugar as to render a juice which is rich in sugar not so manageable as poorer juices. According to Michaelis, who has devoted considerable time to the examination of the juice of the sugar beet, (Zeitschrift für Rübenzucker-Industrie, Band v, p. 261,) the following substances are present:

1. Sugar.
2. Black oxidizable matter.
3. Pecton.
4. Fat.
5. Gum.
6. Legumin.
7. Albumen.
8. Phosphoric acid.
9. Oxalic acid.
10. Citric acid.
11. Acid peculiar to beet.
12. Chlorine.
13. Potassa.
14. Soda.
15. Silica.
16. Iron.
17. Manganese.
18. Magnesia.
19. Lime.

To these have since been added sulphuric acid, asparagin, and some matters derived from humin and ulmin. The vegetable acids present in variable proportions are likely to interfere at times with the stability and capability of separation of the sugar by impeding its crystallization.

Mr. E. C. Erfling, of Council Bluffs, Iowa, informs the Department (December, 1870) of the result of his growth of white Silesian, as producing a fair and good-sized beet, the juice of which, on the 1st of September, yielded 6 per cent. of sugar. The crop was dug on the 15th of October, and a space equal to ten feet square (planted one foot apart each way) yielded 216 pounds of root. This was an average of the whole. He also cultivated other varieties. By selecting roots of 3 pounds weight and examining the juice for sugar, he obtained, from the white Silesian, 12 per cent.; Vilmorin, 11 per cent.; Knamer's electoral, 10½ per cent. Beets of this last variety, weighing 12 to 16 pounds, yielded an average equal to the last-mentioned figure. No sugar was manufactured at the farm during the year, the object being to ascertain the possibility of growing beet in that locality.

In a communication from Chatsworth, Livingston County, Illinois dated December 21, 1870, the Department is informed as follows:

Of the seeds sent me for experiment during 1870, I have the honor to report, first, the varieties of sugar beet, viz: No. 1, white Silesian green top; No. 2, Vilmorin's improved; No. 3, Knamer's improved imperial; No. 4, Knamer's improved electoral; No. 5, white Silesian red-top; No. 6, Knamer's electoral. They were sown in drills 18 inches apart on the 23d of April, and cultivated exclusively by hand, kept entirely free of weeds, but not earthed up, as is usual in the cultivation of beets for sugar. This was done for the purpose of determining the relative growth of each variety above ground. No. 1 grew above ground 4½ inches; No. 2 grew above ground 3 inches; No. 3 grew above ground 3 inches; No. 4 grew above ground 4 inches; No. 5 grew above ground 3½ inches; and No. 6 grew above ground 6 inches. Nos. 2, 3, 4, and 5 gave at the rate of 8.75 tons per acre; No. 1 gave 10.25 tons per acre; No. 6 gave 12.50 tons per acre. Topped at the intersection of the crown with the body of the beet. By polarization, they gave, the weight of juice being taken by Brix's saccharometer, as follows:

Numbers.	Brix.	Sugar of polarization.	Not sugar.
1	12.25	10.24	2.111
2	12.25	9.31	2.94
3	13.00	9.97	3.03
4	13.25	10.51	2.74
5	14.00	11.24	2.70
6	13.25	10.35	2.90
7	13.25	10.29	2.96
8	14.00	10.57	3.63

No. 7 was imperial beet, of our own importation, and No. 8 was electoral beet, seed raised by ourselves. It will be seen from the above that the best results were obtained in every case from the electoral seed, but it must also be acknowledged that the seed of the other kinds was, much of it, impure, or mixed. The polarization was made November 24, after they had made their full growth, and were sufficiently touched by frost to develop their full amount of saccharine matter.

WESTERN, OR "ALKALI" SOILS.

C. P. Huntington, Vice-President of the Union Pacific Railroad Company, forwarded to the Department three samples of soil, marked Nos. 1, 2, and 3, from the neighborhood of the Truckee River, in Western Nevada. Although presenting some difference in physical texture, they are soils of the same character, and derived from the same mineral source. They arrived in two barrels and one box, and were selected from different though not distant locations, near White Plains Station, on the Union Pacific Railroad, in 118° 48′ west, and latitude 39° 54′ north. Elevation of the White Plains Station, 3,291 feet above sea level. The station lies north of the Mirage Lake, a body of water a little over one mile long, and of square figure, occupying a portion of the level plain called alkali flats, along which the wagon-road and railroad run their course. The soils of the locality present some features which are interesting, because they are soils which may be considered primitive and not yet brought into cultivation. They are also in a locality where the annual fall of rain is small and the evaporation so much greater, that not only is the superficial soil deprived of its water, but also the overflow of basins of water situated on a higher level, on the base of the Sierra Nevada, is unable to run any continuous course without drying up completely, as do the rivers and streams farther south, in the Mohave and Gila Basins, and along the Mexican border.

The examination of these soils has been conducted in three directions: 1. As regards their physical properties. 2. As regards their chemical constitution. 3. As regards their capability of sustaining vegetable growth.

1*st*. *Physical properties.*—The three soils are all of a greenish color, varying to light yellow or darker brown, in proportion as the amount of clay of a fine yellow texture, or reddish sand-rock, or greenish amphibole prevails. No. 1 is the darkest, then No. 2, and No. 3 is of the lightest tint.

Taking ordinary water at 60° F. as the standard, a given volume of the three soils weighed as follows. The method adopted was to pulverize the soil very finely, and to fill a beaker to a given line with the powder, not shaking down unduly in any of the samples. The weight thus obtained was contrasted with the weight of the same bulk of water.

Water	83.500 grams.
No. 1	106.370 grams.
No. 2	93.850 grams.
No. 3	89.701 grams.

This, while it does not give the relative weight exactly, shows still the light character of the pulverized soil.

Soil taken from barrel No. 1 is the least clayey of the whole, falling to powder very readily when dry; the color is a dark gray and yellow green. When the finer clay has been washed away by elutriation from the heavier particles, there remains, 1. Angular quartz grains, hornblendic grains. 2. Reddish sand-rock, scales of mica. 3. Shields of cypris, comminuted shells of testacea.

The soil from barrel No. 2 is lighter in color, does not fall into fine powder so readily, and the soil in drying aggregates into nodules capable of passing through a mesh of 1½ inch. The plan of elutriation yielded:

1. Cypris shields, fragmentary shelly particles. 2. Quartzose, hornblende, porous calcareous rock, particles of quartz, scales of mica, round clay casts.

Soil No. 3, (from the box,) lighter-colored than No. 2, less absorbent and adhesive, otherwise in texture closely resembling No. 2. Elutriation disclosed, 1. Dark green amphibole grains, feldspar fragments, red sand-rock, mica scales. 2. Cypris shields, flattened, discoid, helical shell, (planorbis?)

There are few masses in these soils larger than coarse sand, so that they are good examples of material deposited in tolerably deep and still waters, the material derived chiefly from hornblendic and feldspathic clay rocks. There does not appear to have been any transport of lime-bearing rocks, the lime found by analysis being that of the testaceous fresh-water coverings alluded to.

Chemical constitution.

In 1,000 parts.	No. 1.	No. 2.	No. 3.
Moisture	17.17	25.00	40.27
Saline matters soluble in water	45.90	70.36	87.50
Earthy matters insoluble in water	936.93	904.64	872.23
	1,000.00	1,000.00	1,000.00

Along with the moisture are reckoned very slight amounts of vegetable matter which were in the soil, not, however, sufficient to tinge the solution of soda carbonate acting upon the soil for one hour at a boiling temperature. There was here and there a slight bunch of fibrous roots as of grass.

Saline matters soluble in water, solutions slightly alkaline.

	No. 1.	No. 2.	No. 3.
Chloride of sodium and potassium	4.07	5.760	7.11
Sulphate of potassa	0.11	0.306	0.38
Sulphate of lime	0.41	0.97	1.26
Sulphate of magnesia	faint trace.	trace.	......
Iron	......	trace.	......
Phosphoric acid	trace.	trace.	trace.
	4.59	7.03	8.75

Earthy matters insoluble in water.

	No. 1.	No. 2.	No. 3.
Silica, &c	70.80	68.98	72.05
Soluble silica	1.05	1.05	0.81
Peroxide of iron and alumina	8.59	9.34	14.94
Carbonate of lime	18.10	18.84	9.26
Magnesia	traces.	0.53	0.46
Phosphoric acid	traces.	0.60	0.43
Chloride of sodium	0.34	0.42	0.31
Potassa	1.12	0.12	1.26
	100.00	99.88	99.52

It is evident on inspection of the analyses that these soils are not infertile. They are not wanting in any of the elements of soil which the majority of plants require, and the inspection of the coarser parts of the clay shows that the mineral matter of which it is made up is of that character to supply by its degradation a reasonable amount for

future demands. There are silicates of lime and of iron, of alumina, and of potash in abundance, and the calcareous matter is in ample proportion, not requiring addition even during fall-cropping over many years. It is remarkable that the lime carbonate seems to be wholly due to the presence of the shields or shells of the fresh-water *ostracoid cypris*, which exist in considerable numbers in the clay, and which may be readily exposed by elutriation. The existence of this recent Entomostracan points to the existence of large beds of fresh water at no distant period, covering up this district, and as all the samples of clay abound in this shell, the probability is that the inland sea extended to the very lower slopes of the Sierra Nevada, of which sea the present lakes scattered along the base of the Sierra are representatives. Although the presence of carbonate of lime is not indicated in any mineral form, but apparently only existing in the shell of the cypris, yet it is obvious that this animal secreted it from out of some salt of lime in solution in the waters of that time. The perfect condition of the shell indicates that it had its origin in its present habitat, and the conclusion is, therefore, that at some not far distant period the surface of this region was covered by an extensive inland lake. One of the facts exhibited by the analysis is the unusual amount of matters soluble in water which exist in these soils, being: No. 1, 4.59 per cent.; No. 2, 7.63 per cent.; No. 3, 8.75 per cent. These proportions of soluble saline matters are so much in excess of what is found in ordinary soils that they demand investigation into the cause. In fertile soils, in well-watered districts, and where there is an abundant fall of rain, the soluble saline matter rarely amounts to one-half of one per cent., (0.5,) and more commonly ranges around one-quarter of one per cent., (0.20–0.33.) Professor Anderson, in his Elements of Agricultural Chemistry, gives a few examples of the proportion of soluble salts in rich Scottish and other soils, viz:

Soluble matter in surface soil.

Mid-Lothian	0.2319
Perthshire	0.1191
Island of Antigua	0.3700

In the many analyses of soils made in this laboratory, the soluble saline matter has never reached one-half of one per cent. It is to be regretted that a uniform method of analysis has not been adopted by chemists for the analysis of soils, one of the features of which should show the per centage of soluble salts. The experiments with lysimeters do not supply this needed information. It would not be hazarding a misstatement to declare that the poorest of these soils in soluble matters contains eight times as much as fertile soils need, and No. 3 contains fifteen times as much.

Another point of peculiarity in these soils is the amount of sodium chloride (common salt) present, it being from three-fourths to four-fifths of the whole soluble matter. This is far in excess of any usual proportion, and of what is needed. In the Antigua soil, already mentioned, the chloride of sodium did not exceed 0.09 in 100 parts. In many of Sprengel's analyses, as quoted by F. W. Johnston in his Agricultural Chemistry, the proportion lies between 0.06 and 0.009. In no case has it appeared to reach one-tenth of one per cent. In limited sections of a country where tidal or salt-marsh water has opportunity to settle and develop vegetation having a necessity for salt, the amount of that mineral in specimens of the soils may have a much larger amount. Thus,

in the soil in the neighborhood of the Zuyder Zee, in Holland, the amount of common salt in the soil down to various depths is as follows: At surface, 2.010 per cent.; at 15 inches, 2.113 per cent.; at 30 inches, 2.304 per cent. These are very unusual quantities of this mineral, and it most likely would in dry climates diminish very materially the fertility of the soil. But in a moist climate the effect of the rains is to lessen the amount of sodium chloride by washing it out, and this Holland soil shows the influence of the rain-fall in decreasing the amount of salt in the upper layers of soil, even though at the same time there is a process of capillarity going on in warm sunshine, by which the upper layers of soil are made richer in soluble mineral matter than the subsoil. All soluble saline matters, however useful or necessary they may be, impede the rapid growth of plants if they are presented too abundantly or in too concentrated a solution to the roots of plants. "One of the functions of the soil," says Voelcker, "appears to be to transform such readily soluble compounds into combinations so little soluble in water that they pass in common life as insoluble, but which are still sufficiently soluble to supply the growing plant with the necessary amount of mineral food in a state of solution." Taking this as a correct statement, there is no doubt that one of the causes of infertility in these soils, and in the districts from whence they are supplied, lies in their excessive amount of common salt in the upper layers of soil. They are not, strictly speaking, "alkaline" soils; they are rather *saline* soils. Their alkaline reaction is feeble, and does not appear to be due to carbonates of soda or potassa.

How is this excessive amount of common salt in the soil to be dealt with? 1. Can it be eliminated? 2. Is the extent of territory over which it is spread such as to prevent any physical or textural amendments by mixing with other soils? 3. Do the same natural means exist in Nevada as in Holland for its decrease? Is there sufficient rain-fall? I fear that an affirmative reply cannot be given to any one of these questions. The only methods of improvement are by admixture or by percolation. The method of admixture has been tried by experiments conducted in this Department, in which plants were attempted to be grown in these soils both in their natural state and when admixed with variable proportions of fine white sand. The experiments were conducted as follows: A number of pots filled with the soils Nos. 1, 2, and 3, were sown with seeds of corn, (maize,) asparagus, brassica, rape, and beet, (Vilmorin's imperial.) These were placed in the green-house, with a constant heat above 70° Fahrenheit, and well watered. The seeds sown did not vegetate, except the corn, of which a small portion germinated, and when the cotyledon appeared above the soil it dried off into a saline external crust, and the interior became soft and black from rot. The experiment was unsuccessful. Another set of pots were filled with samples of these soils, mixed with sand in variable proportions, and similarly disposed in the green-house. Great care was taken in these latter experiments to prevent any loss of common salt from the earth by the daily watering, the drainage of the earths into dishes below being constantly returned. The results obtained from this second set of experiments were more encouraging. Three forms of admixture, marked respectively Nos. 1, 2, and 3, were experimented upon as follows:

No. 1	Clay 600; sand 600.
No. 2	Clay 300; sand 600.
No. 3	Clay 200; sand 600.

The clay used in these experiments was that described as No. 1 in this report, so that the percentage of common salt in the three series of ex-

periments in each of the pots was, in No. 1, 2 per cent.; in No. 2, 1.33 per cent.; in No 3, 0.81 per cent.

Results of experiments No. 1.—The Vilmorin beet grew to one inch high, and then died. The whole of the plants were stunted and dwarfed. The corn germinated and attained a height of five inches, developed two leaves around the stalk, and then died; the plants also dwarfed.

Experiment No. 2.—Vilmorin beets grew favorably after germination for two weeks, when they also died; the plants were dwarfed, but green and otherwise apparently healthy; a large number of the seeds planted germinated. Of the corn about half the number of seeds planted germinated, the stems growing to seven or eight inches high, but thin, feeble, and not well developed in color. After three weeks' growth they did not appear to further mature, but preserved the green color of the leaf as long as watered. After three months they were removed from the green-house.

Experiment No. 3.—The seeds of the Vilmorin beet germinated more abundantly than in the previous trials. They did not appear to grow any larger, individually, than those of No. 2, merely in greater numbers. A much greater proportion of kernels of maize germinated in this soil, and the plants were much more healthy, two of them tillering with stems ten inches high and larger leaf twelve or fourteen inches long. This specimen of corn would have continued to grow had the season or temperature been sufficiently warm, but as autumn was almost over, the corn made no progress after three weeks from planting. The cotyledons of some of the seeds in this pot rotted in the way described in the record of the first experiments.

These experiments clearly indicate the reason of the failure of growth. There was abundance of water supplied in all of them. The failure was not due to want of water. But even in experiment No. 3, where the proportion of common salt was reduced to .81 per cent., the kernels of corn rotted after germination, and the beets died after growing two inches high. The diminished amount of salt present allowed a larger number of seeds to start; but the entrance of the salt too abundantly in the growing plant at an early period of life choked out the other mineral supply, and the plants ceased to grow.

This experiment showed a limited success arrived at by admixture of the soil, but not to that extent to justify any recommendation being made to improve these soils on a large scale, by hauling soil from other localities, or by deep plowing to turn up the subsoil and mix it in. It is not likely that, at the usual depth to which plows reach, any lesser amount of salt would be found in the soil, but the reverse.

The only mode of treating these soils, then, is by the percolating influence of water, which, flowing through the surface soil, and draining off into lower channels and river-beds, carries off from the soil a certain and considerable amount of the salt. This is naturally accomplished by the rain-fall; for the annual amount of which within this district we have no exact data on which to depend. But judging from similar positions on our continent, it must be slight, perhaps under seven inches, which amount does not fall wholly in the growing season, in which case the rain fall cannot be depended upon for the needed supply of water, and hence the only alternative is that of irrigation from distant water-courses, the supply from which must be abundant to be of value during the first few years. After the growth of salt-loving plants for a couple of seasons, and the washing off of some of the salt by the flooding of the fields, then the soil may be deprived of sufficient excess of the saline matter to allow of roots, such as potatoes, turnips, &c., being raised.

When the soil is well irrigated by field flooding, then almost any crops may be raised, but the beet appears to be that which should be first cultivated. Potatoes will not thrive except where the soil is well washed.

Inasmuch, then, as from the physical and chemical examination of these soils it is evident that they contain no poisonous ingredient, that they contain all the elements of fertility, and that the only reason why vegetation does not readily grow on them is because they possess too much soluble saline matter consequent on the too dry climate and want of sufficient river waters, there is abundant reason to hope that, although the district itself may not be able to supply water of irrigation in sufficient quantity, that engineering skill may be brought into play to derive it from those sources where it is abundant and constant.

MEAT EXTRACT.

Having received samples from the office of the Quartermaster General of the United States Army, an opportunity was afforded of making an examination of the "Extractum carnis Liebig," manufactured by the San Antonio Meat Extract Company, Texas.

The extract was of a flesh-brown tint, of agreeable meaty odor and flavor, and of that consistency to adhere to the fingers when handled, though showing no disposition to settle down rapidly or to flow, as semi-liquids do. It preserves its odor for a considerable time when exposed to an open-air temperature, (70° F.,) while at the same time it undergoes an appreciable loss of weight by drying. By the exposure of its solution for several days it undergoes a slow fermentation without the evolution of sulphuretted hydrogen. A faint odor of carbon disulphide is mixed with the sweetish-sour fermenting odor. By two experiments it yielded in 100 parts—

	1.	2.
Moisture	17.684	17.422
Organic matter	61.616	60.728
Mineral ash	20.700	21.850
	100.000	100.000

The extract is readily soluble in water, especially when the water is warm, in which case it wholly dissolves. It has a marked acid reaction Digested with ether, no matter soluble in that fluid was withdrawn. The absence of fatty matter was thus proved. Treated with alcohol, it partly dissolved, so that the materials soluble in the two solvents (alcohol and water) may be set down as follows:

Soluble in alcohol, creatinine in crystals, phosphates, and chlorides of potassium, and colloid animal matters	13.60
Soluble in water, creatine, inosate of potassium, sarcine, albumen, gelatine, lactates, &c	48.01
	61.61

By ultimate analysis the extract yielded on two experiments the following percentage of nitrogen:

First experiment	9.38
Second experiment	9.55
Average	9.47

Of protein derivatives, the following:

Albumen	2.6
Gelatine	7.7
Total	10.3

The ash consisted of alkaline and earthy phosphates and sulphates, (chiefly potassium salts,) and alkaline chlorides and carbonates, the latter derived from combustion of organic acids. If the nitrogen be divided up between the protein derivatives, albumen and gelatine, and the creatine derivations, it would be thus:

Nitrogen in albumen and gelatine	1.48
Nitrogen in creatine class	7.99

which would allow the presence of nitrogenous nutritive elements of the latter class equal to 23.97 per cent., and the total percentage of nutritive nitrogenous compounds would be 34.27 per cent. If fresh beef be taken as unity, after the fat and bone are removed, the extract may be compared with it in nutritive value thus:

In the absence of water it is as	4 to 1
In the amount of ash it is as	13 to 1
In the amount of nitrogenous principles it is as	$3\frac{1}{10}$ to 1
In the amount of nitrogen it is as	3 to 1

It may be remarked that as this extract leaves much muscular flesh and nutritive matter out of its composition, it cannot properly be compared with the fresh flesh of animals; and it should only be looked upon as an addition to or supplement of the healthy ration, and not as a substitute therefor.

There is a likelihood that considerable error exists in the minds of many with regard to the nutritive value of the several beef extracts made after the method described by Liebig; and although there may be some difference between the extractum carnis prepared by the San Antonio Meat Extract Company and that which professes to have the stamped name of Pettenkofer on the package, yet the value of any extract so prepared is overrated if looked upon as a protein—yielding aliment in any degree equivalent to fresh meat. These extracts are generally prepared upon the following considerations: lean fresh meat contains about 25 per cent. of solid matters, of which from seven to ten parts are soluble in cold water. More than half of this soluble part is composed of albumen and miochrome, (coloring matter,) which are coagulated by heat. Should the solution be boiled these matters are thrown down, and there remain only the other soluble constituents, which do not exceed from 3 to 4 per cent. of the meat. This is the extract of meat of Liebig, when it is evaporated to dryness. It is impossible to recognize in such an extract any great nutritive power, for it is made up mostly of two acids—*lactic* and *inosic*—with the organic bodies known as *inosite*, or muscle-sugar, *creatine*, and *creatinine*, along with an organic colloidal matter of brown color and sirupy consistence; the soluble salts of the meat, chlorides of sodium and potassium, and phosphate of potash are also present. Now, since to obtain one pound of this extract it is necessary to make use of 30 to 34 pounds of lean meat, or from 45 to 48 pounds of butcher's meat, a belief has arisen that all the nutritive matter of this large amount of muscle is concentrated in the one pound of extract. But Liebig never claimed this for it, but only called it bouillon, or a concentrated beef tea deprived of its albumen, and to which it is necessary to add peas or beans, or some substances rich in albuminous matters. It is impossible that nutrition can be carried on by extracts such as these, unless albumen, or some sub-

stance capable of representing it, be added; and the pleasant flavor of the extract will render even an unsavory substitute palatable.

It must be remembered that bulk, as well as quality, is a necessary element in our daily meals, and that not merely to support the wear and tear of life, but also to supply material for active exercise of body and mind, there are required 3 ounces of protein matter as dried meat, or 15 ounces of fresh, and 23 ounces of carbohydrates, or of starchy, gummy, and saccharine matters. This is the daily allowance to farm laborers in England, and is somewhat less than is given to field hands in either Scotland or Ireland. This is much below the soldier's ration in any country while he is on active service, and very much below what has been allowed in our own army during the rebellion.

The meat extract of Liebig does not contain within itself all the elements of nutrition, being destitute of fatty and albuminous matter, without which health and muscular power could not be continued. It is an agreeable soup, giving flavor to other articles of nutrition, both nitrogenous and amylaceous, and with this understanding it should occupy a deservedly high position in the list of commissary stores of an army, and ought to be in constant employment in hospitals and similar institutions, where it is desirable to present an ordinary or nutritious diet in the most palatable form. There appears to be considerable difference in the composition of meat extracts prepared by different manufacturers, which is to be regretted, as, since they are sold under a similar name, the public are led to believe them equal in value as articles of diet.

INDIAN FOODS.

Several kinds of natural products, used by certain tribes of Indians as food, have been presented to the laboratory for examination by Dr. Edward Palmer, who collected them in person. As a paper upon them is prepared by Dr. P. for this volume, I shall only insert the composition of the two varieties the analyses of which are completed at this time, viz: the "soap berry," *(Sapindus marginatus,)* and the "juniper berry," *(Juniperus communis.)*

	Soap berry.	Juniper berry.
Water, (loss in vacuo at 140° C.)	18.16	14.34
Protein compounds, albumen, gluten, &c.	14.44	5.69
Starch	12.10	17.87
Sugar	14.71	10.66
Cellulose, oil, gum, &c.	36.98	47.58
Ash	3.61	3.86
	100.00	100.00
Containing nitrogen	2.31	0.94

As articles of food or breadstuffs these differ from cereals in the diminished amounts of starchy and fatty matters. In the proportion of nitrogenous compounds there is considerable variation in these two, that of the soap berry being nearly three times as abundant as that of the juniper; as far, therefore, as muscle-forming elements are concerned, the juniper as a nutritive food is very inferior. On account of the want of due relation between the amylaceous and the albuminous compounds in both, the breads made of these berries are imperfect substitutes for the cereal plants.

THOMAS ANTISELL,
Chemist.

Hon. HORACE CAPRON,
Commissioner.

REPORT OF THE BOTANIST.

SIR: I have the honor to present the following report of botanical transactions of the past year, and of the present condition of the herbarium under my charge.

The additions to the herbarium, comprising upward of four thousand species of plants, have been derived from the following sources: From the Smithsonian Institution, through the admirable system of scientific exchanges so extensively carried out under its supervision, a large and valuable collection of dried plants, mainly Russian, sent by the Imperial Academy of St. Petersburg. This collection, authentically labeled, comprises one thousand three hundred and forty-eight species, and is of special interest as representing a flora in many points analogous to our central and western districts. Also, from the same source, a set of German plants, including about four hundred species, sent by Professor Paul Reintz, who, in his accompanying letter, requests in exchange sets of American plants.

Besides these large packages, numerous smaller miscellaneous collections have been received, from time to time, through the Smithsonian Institution, both from this country and from abroad, including a variety of fruits, woods, fibers, and other vegetable products.

Professor Wm. Boeck, of Christiana, Norway, on his recent visit to this country, presented to the Department a choice set of plants collected by him, during the previous season, in the high mountain districts of Norway.

On the joint recommendation of Professors Torrey and Gray, a very full collection of Cuban plants, containing one thousand seven hundred and fifty species, was procured from the enterprising botanical collector, Mr. Charles Wright. A large number of these are recent discoveries, now in process of publication in the Revisio Flora Cubana, and the entire set serves to represent the main features of the West India flora.

Of North American plants, contributions have been received from a great variety of sources, of which the following may be enumerated as the most important, viz: A very choice collection from Southern Arizona, collected by Dr. Charles Smart, while stationed as army surgeon in that district, in 1867. The set presented to the Department, embracing nearly three hundred specimens, includes many very rare plants, and probably several undescribed species.

From Dr. C. H. Alden, United States Army, has been received a collection of one hundred and seventy-five species, made during the previous season in Wyoming Territory.

A numbered set of Rocky Mountain plants was sent to the Department by Dr. J. T. Scovell, of Central City, Colorado, with the request to return the names of the plants so numbered.

From Mr. J. E. Johnson, of St. George, Utah, have been received, from time to time, interesting specimens of live plants, and seeds of such as are peculiar to that remote district.

The explorations of Dr. Edward Palmer, continued during the past season in Southeast Utah, Western Arizona, and Southwestern California, have made large additions to the botanical material for elucidating the peculiar flora of those districts. Quite a number of new species are contained in the collections heretofore received, which are now being studied and collated, with a view to their early publication. The numer-

ous duplicates are eagerly sought by prominent botanists in this country and Europe, and will furnish the means for profitable exchanges.

Mr. E. Hall, of Menard County, Illinois, has continued to forward parcels of western grasses, in illustration of several papers published by him on this special subject. From the same source has also been received a small set of Illinois mosses.

Dr. L. D. Gale, of Washington, D. C., has also donated to the Department a collection of plants from this vicinity, including a set made thirty years before, together with a collection of the oaks found in this District.

A short excursion made by the writer, in June last, to the mountains of East Tennessee, has supplied some desiderata in the general collection, including some of the rarer plants of the Southern Alleghanies. It is in contemplation to make a more extended examination of this region during the present season, (1871,) including collections of living plants and seeds of such as are desirable for garden cultivation, together with detailed observations and collections illustrating the forest growth of this timbered district.

The active coöperation of the working botanists of this country has been freely sought, and the results of their joint labors will appear in due time, with suitable acknowledgments of the sources whence their material has been derived. In view of the great amount of interesting material thus accumulated, it is very desirable that some suitable means for extended publication should be inaugurated. The greater portion of the official time of the botanist has been necessarily taken up in the mechanical work of arranging and assorting specimens, with a view to convenient reference and future study. This necessary preparatory work, which might profitably employ several hands, has allowed too little time for preparing results for publication. It is hoped that arrangements may soon be made for commencing this more important work by a series of illustrated papers on botanical subjects connected with the Department collections. Among the subjects requiring earliest attention is that of American forest trees, in regard to which much useful material has been accumulated since the latest publications on this subject.

During the past season the writer availed himself of a three months' leave of absence to visit England, with the special object of acquiring information in reference to matters of botanical interest directly connected with his official duties. The following sketch of an extended visit to the Royal Gardens in Kew, London, is presented as a partial result of these observations:

SKETCH OF THE ROYAL GARDENS AT KEW.

As a public institution, available for purposes of scientific instruction and popular recreation, the Royal Gardens at Kew, in England, do not date farther back than the year 1840. At this time they were officially transferred from the exclusive hands of royalty to be devoted to public uses, being then placed under the efficient directorship of Sir William J. Hooker. Much of the present world-wide celebrity of this establishment can be directly traced to the persevering, judicious, and enlightened policy of this official head. A most happy combination of rare personal attractions, together with a high order of executive ability, joined to untiring industry, enabled Sir William J. Hooker, during his directorship, commenced after the fiftieth year of his age, to carry out a scheme of improvements which will forever associate his name with all that is worthy of admiration in this model horticultural and scientific

establishment. Equally fortunate is it that the plans and policy of the honored father have descended to a not less worthy son, the present director and distinguished botanical explorer, Dr. J. D. Hooker.

To us, as Americans, the main interest in an examination of such an Old World establishment is in the advantage it offers of profiting by wise experience in directing similar institutions adapted to our own immediate soil and climate. Hence the accompanying brief sketch is offered under the following heads, viz: The gardens and grounds, the green-houses, the herbarium, and the botanic museum.

The gardens and grounds.—The grounds, located about ten miles from the central business portion of London, and accessible by several lines of railway three or four times every hour in the day, comprise in their whole extent 345 acres. The general surface, in part fronting the river Thames, is agreeably diversified by elevations and depressions. The rise of the tide here, varying nearly 20 feet, affords ready means of supplying artificial lakes, thus giving the additional charm of water scenery to the varied landscape. A large portion of the grounds is occupied by a heavy growth of native forest trees, composed mostly of beech and oak, while shaded paths in imitation of natural rural scenery are bordered by irregular clumps of rhododendron and holly. In the more strictly scientific portion of the grounds, plants, trees, and shrubbery are arranged according to the natural orders, either in detached beds, groups, or avenues, as best suits the requirements of soil and exposure. The plan is to be carried out, as far as practicable, of bringing side by side the analogous forms of different countries, and presenting at a glance their peculiar character and special adaptation for local cultivation. Thus an avenue of pines will be set out with European representatives on one side and American on the other. Groups of maples, oaks, &c., will be set out on the same general plan, each species being plainly marked with name and native locality. In reference to smaller shrubbery and herbaceous plants, distinct beds will be assigned to each, bringing allied families, as far as practicable, into close proximity. In order to carry out these views in detail, much time and labor will be required, but, even in its present imperfect condition, much useful information is embodied, showing clearly the utility of the general plan; and in carrying on the necessary experiments useful experience will constantly be gained in reference to the peculiar habits and special adaptation of particular plants. In passing over the grounds where cultivation has been of longest continuance, the eye will be frequently attracted by unexpected forms, often in strange combinations. Thus, we meet with magnificent specimens of the cedar of Lebanon, the oriental plane tree, and the wide-branching Turkey oak, associated with the stiff forms of the Chilian *Araucaria*, the Japan *Sophora*, and American *Magnolia*. The Himalayan Deodara cedar stands side by side with thrifty growths of the American giant *Sequoia*. Douglass spruces and California pines vie in luxuriance with native species, while here and there stunted forms show plainly the effect of adverse conditions on species which we might theoretically expect to flourish in such locations.

To one accustomed to the exuberance of our native forests in Eastern North America, in thus seeing how much can be accomplished in less favorable localities in multiplying the forms of cultivated tree growth, it is difficult to resist the conclusion that a more extended experience on our own soil will result in far richer and more varied arborescent productions. Hence, there is special value to be attached to experi-

ments, however limited, in testing the capacity of particular districts for forest cultivation of both native and exotic trees.

The green-houses and plant-stoves.—The green-houses, including nine different structures, are scattered over the grounds either singly or in groups, each being specially adapted in the degrees of temperature and moisture to a particular class of plants. Thus, every grade of vegetation is represented, from that of the tropics to that of the warm temperate zone. Most noticeable of these is the magnificent palm house, constructed entirely of iron and glass, the latter presenting a surface exposure of about 4,500 square feet. The glass used in this, as well as in the more recently built houses, is slightly tinged with green by the addition of oxide of copper, thus obviating to a considerable extent the scorching effect of direct sunlight. This would be a matter of still greater importance in this country, where the solar heat is much more intense during our clearer summer months. In this immense structure, the central portion of which has a clear height of 66 feet from the ground, palms flourish in tropical luxuriance, perfecting both flower and fruit, and rearing their feathered crowns to the extreme height of the building. In other small houses tropical aquatic plants are cultivated in tepid tanks, including the noted *Victoria regia*, with leaves often six feet in diameter, and a succession of showy flowers which open and fade away, and then sink below the surface to perfect their fruit. The necessary conditions of temperature and moisture being here reduced to the simplest character and easily regulated, this class of ornamental plants offer their peculiar attractions at the least expense of care and labor after the first cost of the suitable water apparatus. Other houses, again, are devoted to plants from dry and arid regions, including Cactuses, Aloes, Yuccas, Euphorbias, &c., which are thus necessarily grouped together, though representing very widely separated geographical districts. Besides these, fern-houses, both temperate and tropical, separate apartments for orchids, for cape heaths, and other peculiar classes of plants, are specially provided, together with an extensive structure, as yet only partly completed, intended for what is termed a winter garden or temperate house, thus carrying out the design of accommodating the largest possible variety of vegetable productions. A distinct arrangement of economical and medicinal plants is also provided for, to present at one view some of the principal useful plants in the vegetable kingdom. Ample provision is made in all cases for the accommodation of visitors, by free open passage-ways, with plain printed directions for entrance and exit.

Another useful provision is made for protecting tender plants from injury by sudden draughts of cool air, by connecting the outside with glazed porches, and dividing the inside apartments by frequent partitions connected by closed doors. It is only necessary to see such an establishment in successful operation, and occupied by orderly, attentive visitors, to show how much in the way of instruction and amusement may be profitably connected with objects of scientific interest. It is almost unnecessary to add that what has been accomplished under less favorable conditions of external climate, can be necessarily much improved upon in our own country, where a clearer atmosphere affords the only condition necessary to successful growth that cannot as well be supplied by artificial means.

The herbarium.—The herbarium at Kew, the largest single collection of dried plants now in existence, occupies a separate building, formerly the palace of the King of Hanover. All the apartments of this spacious mansion, including halls and passage-ways, are crowded with cases con-

taining these vast botanical treasures, gathered from every portion of the globe. A necessary accompaniment to these is the botanical library, containing a very complete assortment of systematic works, together with numerous illustrated volumes, both ancient and modern, relating to the science of botany. It is from this rich collection that Sir William J. Hooker derived the material for his numerous serial illustrated publications which, during the active period of his useful life, continued to give light and attraction to botanical pursuits, and aided so materially in stimulating botanical research in distant portions of the globe. Here was also originated that valuable series of descriptive works on colonial botany, still in progress under the experienced pens of George Bentham, Dr. Hooker, and others. The value of this collection especially consists in the fact that it contains the type specimens from which the first descriptions were made, including a great number of North American plants. Hence it will continue to be resorted to by botanists engaged in working up special fa ilies of plants, or clearing up doubtful synonyms. The direct use of this collection in the determination of the garden specimens cultivated in the adjoining grounds, as well as the accurate naming of foreign collections constantly sent there for that purpose, is so evident that the importance of a similar establishment in this country, having particular reference to North American botany, is at once apparent.

The museums of economic botany.—The museums of economical botany, originated by the late director, Sir William J. Hooker, form one of the chief attractions of this establishment. They include, in systematic order, according to the usual arrangement of the different families of plants, such objects as cannot be exhibited in the herbarium proper or in the gardens. The object, succinctly stated as follows in the official guide, is to show some of the practical applications of botanical science:

> They teach us to appreciate the general relations of the vegetable world to man. We learn from them the sources of the innumerable products furnished by the vegetable kingdom for our use and convenience, whether as articles of food, of construction and application in the arts, of medicine, or of curiosity. They suggest new channels for our industry; they show us the variety in form and structure presented by plants, and are the means of direct instruction in most important branches of useful knowledge. We see from them the particular points upon which further information is needed, especially as to the origin of some valuable timbers, fibers, and drugs, in order to perfect our knowledge of economic botany. In brief, the museums show us *how little* as well as *how much* we know of the extent to which herbs, shrubs, and trees contribute to our necessities, comforts, and numberless requirements.

The great success which attended the first experiment soon necessitated the construction of additional accommodations to display the accumulated objects that were brought in from every quarter. Three entire buildings are now devoted to this special object.

Aside from the general plan as above stated, a very interesting personal addition is made by authentic portraits of distinguished botanists and travelers, occupying blank spaces on the adjoining walls and passageways. These are arranged, as far as practicable, in connection with the special department of botany in which each was most noted, or in association with the peculiar vegetable products of regions which they may have explored.

The series, as at present exhibited, comprises two hundred and five full upright cases, besides numerous bulky objects not requiring caseroom, and the entire series of wood sections, which occupy a whole separate building.

The great interest which attaches to such an exhibition of vegetable substances, entering so largely into the different departments of human industry, or directly adapted to the supply of every-day wants, is evidenced by the constant crowds of attentive visitors, few of whom are

content with a single inspection. Such a museum, once fairly inaugurated, never lacks for valuable and constantly increasing additions, and, in this respect, the museum of the Agricultural Department, conducted on a somewhat similar plan, is liable to the same experience as the Economical Museum at Kew, viz: want of case-room, the demand for which constantly exceeds the ability to display properly the articles that are continually accumulating.

In conclusion, I must express my grateful acknowledgment to Dr. J. D. Hooker for obliging attention and unrestrained facilities for inspecting the establishment over which he so ably presides.

C. C. PARRY, *Botanist.*

Hon. HORACE CAPRON,
Commissioner.

AGRICULTURAL METEOROLOGY.

SIR: I present a continuation of my investigations concerning the *influence of climatic agents, atmospheric and terrestrial, upon agriculture.* Space will not permit a review of the multitude of questions embraced in the subject of the influence of the climate upon agriculture, and this report, therefore, will be limited chiefly to the development of the practical side of this great science, without neglecting the known principles which, in the absence of laws, regulate the mutual influence preëxisting between organic and inorganic creation. I have shown the necessity for agricultural reform, and the course to be followed, according to the six propositions enunciated, in order to form good farmers by early education. The instructions on the study of periodical phenomena complete the connection between physical agents and vegetable life. The almost mysterious action of frosts upon plants being little known, I will have to treat as much on the theory as on the practical means of protection. When we consider the enormous annual losses which are occasioned to agriculture by this influence, we appreciate the necessity of studying the subject thoroughly. The study of the physical conditions of different cultivable soils is also a subject worthy the attention of farmers, especially since chemical analysis has taken rank in agriculture.

The world daily discourses about the influence of climate on plants and man, but very little comes from such discussion. Agriculturists also neglect their experience, and fall into that fatal routine which continues from generation to generation. The reason lies simply in the want of a scientific base and a true method of investigation. At other times it depends upon the richness of virgin soils, which demand very little attention; nature does its own work. But when the soil begins to be exhausted, where the climate is unfavorable, and where physical and vital perturbations are felt, the cultivator discovers the necessity of returning to science; even when the conditions of fertility are found, we are not sure that in following this or that method we obtain the maximum of crop which tillage can offer. Every day we perceive our error and introduce new methods. But how? Mostly without fixed principles and after purely casual practice, and, therefore, the results obtained are not satisfactory. Farmers, again, are unable to explain why this or that tillage gives such marvelous production on a soil conclusively reduced, while near to it no human power can obtain the same results; such as the culture of the sugar-cane and tobacco in Cuba,

cotton in the United States, vines in France and Spain, &c. These are facts which highly educated agriculturists know, which the common class of farmers learn, and yet which all seem to forget. It is thus that, in all these questions, we strike the fatal slowness which appears to preside over the law of human progress. How much time and opposition are necessary to attain the discovery of a simple truth! And how much more are necessary to have it accepted and put into practice! To the natural law of intellectual progress, which impels us against our will, we appear to oppose a pernicious routine, which would be prolonged indefinitely if science did not enlighten our pathway. Will agriculturists succumb under the weight of this routine? No! for a progressive nation, like ours, cannot rest stationary in the midst of the advance which proudly places it at the head of modern civilization in other branches of human knowledge. A free and intelligent press will carry throughout this great republic instruction and science, and at last enlighten our agriculturists.

In reading my first report some farmers may have objected that it was more scientific than practical. I must say that the practical aim, whenever possible, will be found pervading the essay with the subject offered. But, where the practical side is wanting, or is not well defined, it is for a forcible reason which often appears; it is because the special branch of science is yet in its infancy, and its practice is not at all determined. In all human knowledge we have first to ascertain the principle or theory by which we can account for any phenomenon, and then to determine the law which regulates it, before we can make any application. If I have not succeeded to my complete satisfaction in the two reports, the failure is mainly due to the insufficiency of science; and this will again show the great necessity for uniting our efforts to reach that practical state so much needed in agriculture.

NECESSITY FOR AGRICULTURAL REFORM AND MODE OF PROCEDURE.

1. In order to discuss all the atmospheric observations and periodical phenomena of plants, made by observers and farmers, a division of meteorology should be established in the Department of Agriculture. The investigations of Buys-Ballot, Francis Galton, and Alex. Buchan, have proved a close connection between the barometric pressure, temperature, and moisture in the prevailing winds and storms, as follows: that where the pressure is the highest, the temperature of the air is the lowest, and *vice versa;* that the wind flows out in all directions from the regions of higher pressure to those of lower pressure; and that the moisture follows the track of the highest temperature. Now, the whole system of wind blows in a vortex upon the spaces of lower pressure, and this is the path pursued by the center of cyclonic storms and hurricanes. We see immediately the important application of this fact to agriculture. Suppose we knew the lines of equal mean monthly barometric pressure, temperature, moisture, and direction of the wind over the whole country, then, by tracing on the map all the stations where the lowest pressure prevails, we should ascertain the exact track which the storm had to follow, as the wind flows from the surrounding stations of the higher to those of lower pressure. Now, weather previsions, as applied to agriculture and navigation, rest entirely upon this rule. But before reaching this point we must work up these monthly charts of the normal state of the atmosphere, in order to know and trace the abnormal state, just as in the human body we must know its healthy condition to cure its diseases.

Another consideration which the meteorological division should take

into consideration, and which shows again what an important bearing temperature has upon agriculture, is the following: In England, farmers believe that if the night temperature falls to 40° F., there is no growth for twenty-four hours, and that the mean temperature of the succeeding day may be expected to be about 46°. In this country a similar law must prevail, probably with different degrees of heat. Then, by observing the monthly charts, and taking note of those localities where temperatures are less than 40°, one would ascertain the places where, during certain months, there is little growth—a very important question in discussing the crops of the United States.

The most useful temperature in agriculture is that required to ripen cereals. It has been proved by observations made by persons competing for prizes offered by the Marquis of Tweeddale, president of the Scottish Meteorological Society, that the ordinary range of temperature in Scotland, necessary to ripen cereals, must average 56° F. If it fell below that, there was a deficiency in the crop; if it rose above it, the crop was so much the better, provided there were rain and other necessary conditions. After ascertaining in the United States the most favorable degree of temperature to ripen cereals, with the monthly charts one could point to those locations where there is some hazard in raising these crops—the places, namely, where the necessary temperature is scarcely to be expected, or where it occurs so seldom that the risk is too great. It is generally admitted that the temperature falls one degree for every 300 feet of elevation, so that, supposing at the sea level there is a temperature of 58°, at an elevation of 600 feet the temperature would be 56°, or a temperature sufficient to ripen cereals. In the same manner a thousand agricultural problems should be submitted to strict scientific and practical tests as to the influence of climate on our American crops.

The meteorological division should have charge of the discussion of all the observations and periodical phenomena sent to the Department by observers and farmers, in order to publish and distribute the following indications:

a. Precise instructions upon the manner of observing their instruments, and the number and nature of meteorological influences which exert any action upon vegetation.

b. Charts furnishing by curves the progress of the principal crops, connected with the lines of equal temperature, moisture, rains, frosts, and other pernicious or favorable influences.

c. Annual charts, and for the largest possible number of past years, giving the geographical distribution of these same crops compared with the same meteorological influences.

d. Instructions and catalogues of the names of trees and plants for the determination of the epochs of foliation, flowering, fructification, and defoliation.

e. Charts giving the monthly geographical distribution of equal lines of foliation, flowering, fructification, and defoliation.

f. The conclusions arising from the discussion of all these observations, with their application to agriculture, furnishing in final result the knowledge of the exact degrees of heat, moisture, &c., that each physiological function of the different plants requires for vegetating normally, and for the greatest production.

g. The primitive catalogue of Quetelet, for the observation of the periodical phenomena of flowering, comprises two hundred and eighty-eight different plants, which were reduced by Fritsch to one hundred and eighteen species, the most ordinary of which are found in almost all gardens. When the Department of Agriculture determines to pur-

sue these researches, it should distribute among its correspondents an analogous catalogue, comprising as far as possible the same American species, or those which approach nearest to European species, in order to preserve a uniformity of method and study upon the two continents. There should be on the same page blank columns, with the indications of the periods of foliation, flowering, fructification, and defoliation, where the date of their appearance may be marked. Another column should be provided for the various remarks which may be made. These pages, once filled, should be returned to the Department of Agriculture, to be discussed by the division of meteorology, and then the conclusions and charts here specified should be sent to correspondents and farmers for their proper instruction, and for application to agriculture.

2. The creation of a network of meteoro-telegraphic observations, especially applied to cultivation, under the direction of the Department of Agriculture.

The Government has just established a chain of stations, under the direction of the War Department, for the purpose of predicting to mariners, by the aid of the telegraph, the arrival of tempests on the coasts and lakes. In 1849 the Smithsonian Institution, under the charge of the secretary, Professor Joseph Henry, established a network of observations for the study of the climate of the United States. These two series of observations have not had, and cannot have to-day, more than a partial and indirect application to agriculture. The reason is very simple. It is because, as shown in my first report, the observations and the meteorological tables must be made and discussed in a manner very different when it is necessary to apply them to agriculture. The question is, to determine exactly the *sum* of heat, moisture, light, electricity, &c., that each species of plant requires for germination, foliation, flowering, fructification, &c.; in a word, for living in the best hygienic condition, and producing the greatest possible yield. The process to be pursued is as follows: We note the day and hour at which we sow the grain, concurrently with the reigning temperature; this we continue to note until we perceive the first symptoms of vegetable life, as soon as the radicules appear and the plumules rise. Then, by adding all the degrees of temperature observed in the first period, and by elevating this amount to the square, we obtain as exactly as possible, according to the number and exactitude of the observations, the accurate degree of temperature that each grain requires for germination. We proceed in the same manner in the interval between germination and foliation, from that to flowering, afterward to fructification, and finally to the leaf-fall, or the invernal sleep of the plant.

If we repeat the same observations in regard to dampness, light, and other atmospheric agents which powerfully affect vegetable organization, we shall obtain all the conditions necessary to scientific cultivation and the greatest production. Why? Because when some function of the plant becomes paralyzed by the failure of something of which we are now ignorant, we shall know that it requires greater or less degrees of heat, moisture, &c. Instead of proceeding blindfold, as heretofore, instead of throwing away time and money in disappointing trials, we shall advance, guided by the light of science, and, so to speak, almost mathematically. This is the difference between cultivation according to routine and according to science.

It will be only after this preliminary study that the network of the Smithsonian Institution, which gives the climatic conditions of different localities, will be very useful to agriculturists when they wish to establish or transport their productions. Having already acquired a knowledge

of the degrees of moisture, heat, &c., which different cultivated productions require under different climates, they will have no difficulty in judging of the conditions of new climates. It is thus, also, that the network of the War Department will be doubly useful in protecting their harvests from atmospheric disturbances, when the normal state of the latter shall be known. They will learn exactly the degree of resistance which they must oppose to these disturbances. By-and-by, when the vital perturbations shall be better ascertained, we shall be able to predict atmospheric disturbances, and *vice versa*. By the delay or advance of different physiological functions of the plant—for example, of the leafing, or spring-flowering, or, further, of the leaf-fall in autumn—it will be easy to predict whether winters will be vigorous or mild. Already, in Europe, when the dandelion (*Leontodon taraxacum*) expands its golden flowers, we are sure that the cold will return no more. So it is that in the vital, and even in the moral state, everything being intimately connected, the sciences aid each other mutually. We conceive now why the meteorological observations for any application to agriculture can be made only by agriculturists, or by observers especially in charge of this study. I therefore appeal to farmers to take these facts into immediate consideration, for it is already time to begin, and, as one man, undertake the task in the interest, particular and general, of agricultural science.

We conceive now how, by a judicious combination of the indications that are furnished by the meteoro-telegraphic observations, combined with the knowledge of atmospheric influences on plants, which follow from the first two propositions, the farmers will obtain an almost incredible degree of certitude in all their agricultural operations.

3. An experimental field should be established in the Department of Agriculture, where all the physical and chemical agents of the soil and atmosphere, which exert any influence on vegetation, could be submitted to profound study and repeated experiments, with the view of discovering the laws regulating vegetable organization.

There still remain a considerable number of questions to resolve and verify concerning the action of different physical agents on a plant; or, more properly speaking, concerning the intimate relation which exists between its physical functions and its agricultural productions. If we consider, for example, the temperature, we are ignorant whether the progress of vegetation is in relation to the simple arithmetical sum of the thermometrical degrees, as Reaumur and others think; or, as Quetelet proposes, to the square of the degrees; or, again, as Babinet supposes, to the square root. If we examine light, the question is not yet settled as to the different actions which the luminous, calorific, and chemical rays exercise upon germination, upon the decomposition of carbonic acid from the leaves, the fixation of carbon, the formation of chlorophyl, &c. In electricity we are still more ignorant as to its pernicious or favorable influence on plants, whether static or dynamic. All these undetermined questions, and many others, were pointed out in my first report, and the same ignorance exists as to the cause and action of frost. No wonder that the distinguished horticulturist, Professor Lindley, should conclude, after forty years of experience, "that the fatal effect of frost upon plants is a more complicated action than has been supposed;" and the only conclusion he has arrived at is, "that the power of plants to resist frost is the consequence of *specific vitality*," of which he knows nothing more. Now, all these important questions, and many others which spring up daily in the course of investigation, should be submitted to a new test in the proposed experimental field,

in order to ascertain the laws which regulate these phenomena. All the diseases of plants known under the generic name of *fungi*, which occasion to agriculture an annual loss of millions of dollars, could also be submitted to experimental researches to discover the origin of these pathological affections, and the means of destroying them and preventing their return. This capital question in agriculture suffices in itself to show the immense utility of such an experimental field, the cost of which would be doubly returned in increased production.

In this way the United States could enter, on a grand scale, upon the path inaugurated in 1822 by the celebrated Horticultural Society of Chiswick, in England. Notwithstanding that its researches were limited to the application of meteorological observations to agriculture, and at a time when this science was making its first appearance, many advantages have been drawn from its conclusions. Again, some years ago, Napoleon III, in the interest of agriculture, established, under the direction of George Ville, a field for chemical experiments applied to agriculture, with a chair of the same in the *Jardin des Plantes* in Paris.

4. It is the duty of the Government to perfect agriculture by all possible means, and, first of all, by creating a body of State meteorologists. We have at present State geologists, whose studies are of great importance in public works outside of science. We have, also, State entomologists, whose studies upon insects which injure agriculture embrace only their determination and habits; beyond this knowledge the entomologist does not advance in regard to the cause of the evil, nor can he furnish to the agriculturist the means of remedying it. Why? Because the attack of the injurious insects upon agricultural productions is caused by some atmospheric or terrestrial perturbation which produces the disease of the plant. The fungoid growth, for example, is the result only of diseased plants, and not the primary cause of their ill-health, which lies entirely in the atmosphere or in the earth. It is the same with animals and men, where, except in the case of fracture, all diseases originate in a want of physical or moral harmony between the organism and the surrounding medium. For that reason the State meteorologist, who discovers the real cause of the disease, or the diagnosis, should precede the State entomologist, who furnishes only the classification and habits of insects, in order to be extinguished by some physical or chemical process.

The duty of the State meteorologist would be to collect and control all the observations appertaining to his own State in the following manner: To form catalogues of storms, floods, droughts, frosts, and earthquakes, from the first settlement of the State until the present time, in order to determine the recurrences, and to prevent possible injury to crops; to proceed in the same manner with the extreme annotations of barometric pressure, force and direction of the wind, temperature, moisture, great falls of rain and snow, and in a general way all the natural phenomena; to establish the special laws regulating the climatic conditions of each State, so as to be able to determine the general law of the whole climate of the United States: and, after a careful discussion of these observations, to apply them to vegetable growth, and to furnish to farmers only such results as would be useful to them. An annual report should be published for the benefit of agriculturists and scientists. All these labors of State meteorologists would have not only a wide application to agriculture, but, in addition, would serve the Government under diverse circumstances, and in the various enterprises of public works in which an exact knowledge of climate is of the highest importance.

5. For forming a class of farmers from youth, it would be necessary to establish in the college of agriculture in each State, a course of physics and of meteorology applied especially to agriculture. These courses should embrace two parts—the one theoretical, the other practical. The starting-point of the first is celestial and terrestrial physics, upon which repose almost entirely the laws which preside over the variations of terrestrial and atmospheric phenomena, and which form the science of meteorology; afterwards comes the study of the phenomena of vegetable life, comprised in the anatomy and physiology of plants; next the mineralogical constitution of the soil and the geographical distribution of the vegetable kingdom will complete this first part, purely theoretical. It is, of course, understood that only such deductions of these sciences are used as are indispensable to the study of agriculture. Agricultural chemistry is a superior branch, which will follow agricultural physics, and the influence of which on the vegetable organization is much more limited and less direct. In the second part, entirely practical, we should apply each theoretical acquisition of knowledge to the conservation, growth, and reproduction of the plant, taking care to establish the action and reaction which always exist between vegetable life, the atmosphere, and the soil. This part would be completed by an experimental demonstration of the physical functions of the plant, and by a new series of experiments for the purpose of perfecting agriculture.

Another means, more economical at first, for diffusing this knowledge, would be the association of all the colleges of agriculture in the United States, for the purpose of contributing a series of annual lectures, which should be delivered by the same professor, for uniformity in theoretical doctrine and especially in experimental methods. These lectures should be perfected each year by the announcement of new discoveries in this branch.

6. Finally, we have long possessed numerous treatises on agricultural chemistry, but unfortunately we have only one treatise on agricultural meteorology, that by the Count de Gasparin, dated 1844, the indications of which are far below modern science. Why this chasm in a branch which constitutes the basis of agriculture? It is because the meteorological phenomena are much more complicated than the chemical phenomena, that chemistry could constitute itself into an experimental science, while meteorology remains in its infancy.

Meteorology, well comprehended, which embraces the great science of the reciprocal influence of atmospheric and terrestrial media upon animal and vegetable organization, could not be constituted before the two bases, physical and chemical, were established. It was necessary first to know the medium and the living being before we could establish the reciprocity of action and reaction between them. On the other hand, physics being the basis of chemistry, it follows that agricultural meteorology is likewise the basis of agricultural chemistry. It is therefore perfectly natural to proceed from physical and chemical phenomena, less complicated, to meteorological phenomena, more complicated. Meteorology possesses already an abundance of facts and accumulated experiments, which only await the moment of their application and the deduction of their reciprocal laws. It is, therefore, time to bring before the public, for the instruction of farmers, a treatise on meteorological agriculture, theoretical and practical.

I have no doubt that, at an early day, the Government will take pride in establishing an experimental field and a division of meteorology in the Department of Agriculture, which, by uniting precision with utility, will make agriculture a practical science, and secure each year the rich-

est harvests. The Government cannot better convert the funds of the nation to the increase of its agricultural products—the primary sources of national wealth. This fact was clearly understood by President Grant, when, in his last message, he said:

The subjects of education and agriculture are of great interest to the success of our republican institutions, and our happiness and grandeur as a nation. In the interest of one a bureau has been established in the Interior Department—the Bureau of Education; and in the interest of the other a separate department—that of Agriculture. I believe great general good is to flow from the operations of both of these bureaus, if properly fostered. I cannot commend to your careful consideration too highly the reports of the Commissioners of Education and of Agriculture, nor urge too strongly such liberal legislation as to secure their efficiency.

The following paragraph, which appeared in the "Albany Cultivator and Country Gentleman" for December 1, 1870, p. 756, shows that the importance of carrying out the project above stated is already felt:

The praise of the weather is on all tongues. And justly, for nothing could be more conducive to health or better for business. * * * And here let me call the attention of Mr. Commissioner Capron to how much could be done in the interest of agriculture, if the weather reports, now gathered by the Government at the principal lake and sea-coast cities, were enlarged so as to embrace reports also from the capital of each interior State. As published now, these reports are useful only to the maritime classes; but were they increased, as here suggested, they might be collated and formulated so as to give a juster idea of the condition and yield of crops than could be obtained in any other manner. The time is at hand when the scientific corps at agricultural colleges, noting carefully the phenomena of the weather, will be able to publish weekly or monthly, as the case may be, accurate estimates of harvested and incoming crops. Then would it not be a feather in the cap of the Department of Agriculture if in this business it took the initiative?

An exposition of this plan having been read before the Farmers' Club of the American Institute on the 27th of December, 1870, the discussion following brought out this illustrative statement of facts from Mr. F. D. Curtis:

I wish to reduce the ideas in the paper of Professor Poëy to my own practical notion of things. I have a field, sloping to the north, which, a few years ago, I observed, was covered with moss growing underneath the clover. Older farmers than I said the unusual circumstance was caused by the dampness underneath the clover: others gave it as their opinion that the land was sour. None of them were right. I have reseeded the lot with timothy and orchard grass, which does away with the clover theory. A hundred dollars' worth of fresh lime has been spread over the surface of the field to warm and sweeten the soil, and last summer was an exceedingly dry one, but still the moss exists; therefore it must be the result of climatic or atmospheric laws which no farmer understands, and they would like to have some one somewhere to study out these mysteries and teach them the laws of their growth and prevention.

A committee, consisting of Messrs. Lyman, Whitney, Bragdon, Curtis, and Reade, appointed to consider this subject, reported at the session of the 17th of January, 1871, as follows:

Your committee consider that the above suggestions of Professor Poëy are entitled to careful consideration by the farmers of this country, and especially those who are shaping the policy and establishing the grades of our agricultural schools. All consider the subject of sufficient importance to recommend that General Capron communicate the plans of Professor Poëy to the presidents of these colleges, and urge them to provide for the careful study and accurate noting of meteorological facts in every part of the republic.

At the session of the 21st of March, the following letter from the Hon. Horace Capron, Commissioner of Agriculture, to the secretary of the Farmers' Club, was read:

I beg leave to acknowledge the receipt of a report of a committee of the American Institute Farmers' Club on a communication from Professor André Poëy on the subject of meteorology, in which this Department is recommended to communicate the plans of Professor Poëy to the presidents of agricultural colleges, and urge the adoption of some such plan of observation as is therein recommended. I have always looked upon the relations of meteorology and practical agriculture as necessarily very close, and that by just so much as our knowledge of that science is increased shall we be likely

to have more certain and abundant harvests, and I therefore think a more extended network of observation in the several States than that carried out by the Secretary of War for the benefit of commerce is desirable for agriculture, and that these should be subordinated to a central office or bureau, in order to make them uniform and utilizable. I have only partially succeeded in impressing this view upon Congress. I have no control over the various colleges alluded to, and the adoption of this plan would involve some additional expense in each institution, and, therefore, I am unwilling to assume the position of adviser, although I am of the decided opinion that the pursuit of such inquiries is a part of the plan of improvement in agriculture which it was contemplated these institutions might effect.

INSTRUCTIONS FOR THE OBSERVATION OF PERIODICAL PHENOMENA.

The name of periodical phenomena has been applied, by Quetelet, to a diversity of physiological functions or habits of plants, animals, and man. While the earth performs its daily and annual revolutions, a series of phenomena are unfolded upon its surface which the periodical return of the days and seasons brings regularly back in the same order. The phases of the existence of the minutest plant-louse are intimately bound up with the phases of the existence of the plant that nourishes it; and this plant itself, in its gradual development, is the product of all the anterior modifications of the soil and atmosphere.

The study of these periodical phenomena, of the highest importance in agriculture, has engaged the attention of observers in all times, from the Greek philosopher, Theophrastus,* down to the great naturalist, Linnæus,† who, more than a century ago, first attempted a series of observations on the flowering period of different species of plants. These observations, addressed to husbandmen, were published during the years 1750–1–2, under the title of "Calendar of Flora."

But this important study was almost abandoned for want of a regular system of investigation, until 1839, when Quetelet began, at the garden of the observatory of Brussels, the first regular series of observations on the period of flowering.‡ In 1841 these observations were carried on in several parts of Belgium. In 1842–'43 they were improved and extended to other nations. In 1842 Quetelet published his "Instructions§ for the Study of Periodical Phenomena," both in plants and animals; while Schwann‖ added his own "Instructions Applied to Man." Quetelet's "Instructions" were translated into English in 1845, and revised and enlarged by a committee appointed by the British Association for the Advancement of Science;¶ they were also translated into German by Ch. Ritter and Mohlmann, and recommended to observers in Germany.

Finally, in the International Congress of Statistics, held at Vienna, in 1857, it was resolved to form a general outline for the observation of periodical phenomena at large, and submit it to the next Congress at London. Quetelet, director of the observatory at Brussels, and Karl Fritsch, assistant at the observatory of Vienna, were instructed to draw up the outline. The "Instructions," written and published in 1859, by Fritsch,** were submitted to the Congress held at London from the 16th to the 21st of July, 1860.

* Libros VI, de causis plantarum, conjuncta opera D. H. F. Linkii, excerpta solus explicare conatus est J. C. Schneider, Lipsiæ, 1818, 5 vol., 8vo.

† Amœnitates Academicæ, seu dissertationes variæ physicæ, medicæ, botanicæ, Ludg. Batav. 1749–'69. 10 vol. 8vo, Td. Erlangæ, 1785–'90.

‡ Memoires de l'Académie des Sciences de Bruxelles, 1841, vol. xiv, pp. 3–5, 19–28.

§ Bulletin de l'Académie des Sciences de Bruxelles, 1842, vol. ix. pp. 65–95.

‖ Bulletin de l'Académie des Sciences de Bruxelles, 1842 vol. ix. 2d part, p. 120.

¶ Report of the British Association, 1845, pp. 321–336.

** Sitzungsberichte der Wiener Akademie der Wissenschaften, 1859, vol. xxxvii, pp 591–636.

The first regular series of these observations made in this country were prepared by T. Romeyn Beck and Professor Joseph Henry, and published at the early date of 1826.* It is to be regretted that, in the "Results of the Meteorological Observations made from 1826 to 1850," and published by the University of New York, under the care of Franklin B. Hough, all that valuable information upon periodical phenomena should have been omitted entirely.

In 1862 Professor Joseph Henry† issued, through the Smithsonian Institution, a circular addressed to observers, for the purpose of obtaining all possible information upon these phenomena, both in plants and animals. Unfortunately, the great importance of this study was not comprehended, and the design of Professor Henry failed for want of assistance.

To ascertain the laws of dependence and relation which exist between these periodical phenomena, in connection with the state of the atmosphere and conditions of the soil, it is first necessary to study them simultaneously, by the aid of observations made at a great number of stations. A single plant, carefully watched, is capable of yielding information of the greatest interest. *Synchronic* lines, or lines of equal phenomena, might be traced on the surface of the United States, to indicate the foliation, the flowering, and the ripening of the fruit of the principal plants. A line might be conceived on this surface upon which the flowering of our principal productions takes place at the same date; and also lines on which the flowering is earlier, or later, by ten, twenty, or thirty days. Will these lines, then, be equi-distant? Will they bear analogies to the *isothermal* lines, or lines of equal heat? What dependence will exist between them? How will it be with the *isanthesic* lines, or lines of simultaneous flowering? Will the latter be parallel to those relating to foliation, or to other clearly marked phases in the development of the individual? We may presume, for example, that, while a plant is beginning to bloom in a peculiar locality, and at a certain date, there also exist other places, to the northward, where the same species is just putting forth the leaves. Has the line, then, which passes through these places, any relation to the lines of simultaneous flowering which answer to the same date? It may also be asked whether the places which have the foliation on the same day will likewise have the same date of flowering and fructification. Thus we may see how, by confining our observations even to the simplest data, many important deductions might be drawn from a system of simultaneous observations conducted on an extended scale.

The periodical phenomena are divided into three great classes, the first two comprehending plants and animals, and the other concerning man living in a social state; for society itself, with all its tendencies to withdraw from natural laws, has not been able to escape from this periodicity of the reappearance, more or less regular, of the same phenomena.

We shall here take into consideration only those periodical phenomena appertaining to plants, which are as follows: 1st, the foliation, or first appearance of the leaves; 2d, the flowering, or first appearance of the flowers; 3d, the fructification or ripening of the fruit; and, 4th, the defoliation, or fall of the leaves. These refer only to the annual revolution of the earth; but for the diurnal revolution, the hour and

---

* Annual Report of the Regents of the University of the State of New York, Albany, 1826.

† Smithsonian Miscellaneous Collections, Washington, 1862, vol. i, pp. 63–70.

day when the flower opens and closes should be marked, at the spring and autumn equinoxes, and the summer solstice.

Observations relative to the vegetable kingdom may be taken from two aspects, the diurnal and the annual periods. The first is the return of the hour at which certain flowers open, and these hours are fixed, being always similar in like species; the second, or annual period, is that which is comprised between the two successive returns of the leaves, flowers, and fruits. The application which may be derived from acquaintance with these phenomena is of the highest importance, not only in agriculture, but also in meteorology and botanical geography.

In pursuing the observations, the principal object should be to make them comparable, so that those of one country may be contrasted with those of another. The chief point consists, then, in the choice of species and the identity of comparative condition, and not in the number subjected to examination. For attaining this object the following instructions have been drawn up by Quetelet:

1. *Observations for the annual period.*—In these investigations annual plants must be discarded, for they often come up at various periods, according to the time when they were sown; therefore the indications furnished by them would not be comparable.* The same advice would also apply to biennials, because they come up slowly and at different times in autumn or spring. The only exceptions admitted are, of the autumn cerealia, rye, wheat, and winter barley, which are sown about the same time, and the phenomena of whose vegetation and flowering form a very important part in annual observations, because they relate to plants so extensively cultivated. The period of their being sown and that of the appearance of the ear should be noted.

Plants for examination should be woody, or perennial; the first are especially important, because they are more subjected to the double combination of atmospheric and terrestrial modifications; and also because they are better adapted than perennials for observations on foliation.

It is important that plants for daily observation should have been planted at least a year; for vegetables transplanted in spring present too much uncertainty in their periods of foliation and flowering, these periods being subordinate to the formation of the roots. In selecting plants, those which flower through the entire year should be avoided, because they have no determined periods, such as the dandelion, chickweed, and common groundsel. All those plants which yield varieties by cultivation should be avoided, as the rose and *Tulipa Gesneriana*, and the pear, cherry, and large-leaved lime-trees. Experience shows that among varieties produced from seed-beds, some flower fifteen days before others. To arrive at the comparative value of the flowering of these plants, it would be necessary to observe everywhere the same variety, and this is often impossible. Such plants as are of nearly allied species and difficult to distinguish should also be avoided. Without attention to this, observers might be employing different species, which would destroy the comparative value of their operations. Finally, all flowers should be discarded whose æstivation does not permit an accurate noting of the exact moment of expansion; such are the *Calycanthus*, *Illecebrum*, *Aquilegia*, &c.

The periods at which rye, barley, and winter wheat come into ear should be carefully noted, this point being of great importance in agriculture. In the district of Tourney, a farmer's axiom is that "April is

* M. Bergsma, president of the Horticultural Society of Utrecht, has, however, truly remarked that annuals might be usefully employed, provided precautions be taken to use in every case the same seeds, and to sow them on the same days.

never seen to go without corn in the ear." It is curious to determine at what period these cerealia put forth the ear in the various parts of the United States, compared with Belgium and other parts of Europe.

Two methods of observation may be employed, namely, with plants wild or cultivated: the former is uncertain, and presents scant facilities, as the observer would have to traverse large tracts and different regions, and never be sure of observing the same plant the second time. It is essential that the daily observations of plants fixed upon for comparison should be made on individuals planted in an airy garden; they should neither be sheltered nor exposed to a south wall. Trees should be selected in open fields, because woods always afford unequal shelter.

Indications of periods for foliation should be made when the leaf-buds first burst; and, for flowering, when the anthers are visible; the same will apply to the *Compositæ*. The foliation period presents difficulties, especially in spring, and therefore I propose to select that moment when, in advance of vernation, the upper face of the outer leaves becomes exposed to the action of the atmosphere and commences its vital functions. Fructification should be noted at the time of the dehiscence of the pericarp in dehiscent fruits, which form the largest number; in the indehiscent fruits it should be noted when they have arrived at maturity. Lastly, the defoliation should be noted when the most of the leaves have fallen, it being fully understood that what relates to leaves can only apply to woody plants, excluding the evergreens, whose defoliation is successive.

To the above observations should be added the modifications which occur in odors, and colors of flowers, leaves, &c.; also the daily indications of mean temperatures, or, still better, the maximum and minimum.

2. *Observations for the diurnal period.*—Independently of the annotations of each day, which form the calendar of Flora, there should be registered in each locality the hour at which certain plants expand and close, when they perform these functions at a determinate time. The daily registration of these results being too tedious, it is proposed to limit them to the equinoxes and summer solstice.*

Quetelet, endeavoring to apply the calculation of probability to periodical phenomena, makes the following remarks: Natural sciences have been until the present time less amenable to mathematical theories than physical sciences, notwithstanding they offer many favorable openings for calculable combinations, and especially the calculations of probability. A striking example exists in relation to periodical phenomena, which may be expressed largely by dates, and translated into numbers.

The causes which it is essential to comprehend are those having an influence upon the progressive development of plants. We may here limit our consideration to the predominant causes, as they occur in physical phenomena, and return subsequently to secondary causes. I shall arrange in four principal classes those causes which may influence the flowering of a plant. 1st. The geographical causes; such as latitude, longitude, and altitude. 2d. The local causes; such as the nature of the soil, the exposure, and the quantity of light. 3d. The individual causes; such as the age and vigor of the plant. 4th. The meteorological causes; such as the temperature, the nature of the winds, the dampness of the air, the quantity of rain, the state of the sky, &c.

It would be very difficult to study all these causes simultaneously, and to comprehend the influence appertaining to each; the surest means would be to proceed from the simple to the composite. To eliminate the

* Bulletin de l'Académie des Sciences de Bruxelles, 1842. Vol. ix. pp. 65–95.

causes which belong to the first three categories, we should always observe identical plants, in the same localities, and with similar soil, age, &c.; the differences existing in the periods of flowering, when we have exhausted all other equal circumstances, may be attributed to meteorological causes. Supposing that it is the same observer who follows the development of the plants, and takes care to register their natural epochs, numerous observers would see without doubt in different ways, one having a propensity to mark the epoch of flowering more slowly than another. This difference, which may be named "the personal equation of the observer," will be a new cause of error, of which it is necessary to take account.

I assume, therefore, that all the precautions have been taken to render as equal as possible all the causes in general, other than meteorological, which may make a difference in the phenomena of vegetation. These conditions are not very difficult to fulfill if we observe the same plants, in identical exposures and localities, during many consecutive years, in order to eliminate by repeated observations the results of casual causes; we should also take care to register the meteorological state of the air, which action is to be determined.

Supposing that we have registered carefully each year the flowering periods of common and unmistakable plants, such as the lilac, *(Syringa vulgaris,)* after a series of years we may take the average of the dates we have preserved, and this average will give the flowering epoch of the plant. This epoch is not, however, so well fixed that it may not be affected by ulterior observations, and we may, therefore, for the present assign a *probable error*. We may also determine the probable digression of an ulterior observation of the date, for example, at which the lilac will flower in the following year.

The table which Quetelet gives* throws more light on the subject. We find there the dates at which have blossomed for fifteen years the most common of plants, viz: the lilac, the syringa, and the *faux ébénier*, and also the average dates of the digressions observed each year.

The celebrated botanist, Martius, remarks that the movements of the sap, studied by the aid of periodical phenomena, and placed in connection with the meteorological derangements, throw a new light upon the history of cells and vessels; the chemical signification of the external development we find more clear; the history of vegetable chemistry consolidates the principles of agronomy.

The average date of flowering may be fixed at the 1st of May for the lilac, the 25th of the same month for the syringa, and the 2d of June for the *faux ébénier*. We see further that the probable error of these dates is nearly the same, and does not extend beyond a day and a half. The probable error is naturally greater for an isolated observation; it is of five or six days; that is to say, that, for the *faux ébénier*, for example, it is an equal chance that the flowering will take place the 2d of June, and that the delay or advance will not exceed five or six days. Although the three plants indicated bloom at different epochs, we see consequently that they have nearly the same delay and the same advance for each year.

ACTION OF FROST UPON PLANTS.

Theory of frost.—From a series of experiments on the "Heat of Animals and Vegetables," made in 1766, John Hunter drew the following conclusions: "That plants, when in a state of actual vegetation, or even in such a state as to be capable of vegetating under certain circumstances,

* Theorie des Probabilities. Bruxelles, 1853, pp. 68–70.

must be deprived of their principle of vegetation before they can be frozen." Again he says: "But the question is this: Is every tree dead that is frozen? I can only say, that in all the experiments I ever made upon trees and shrubs, whether in the growing or active state, or in the passive, that whole or part which was frozen was dead when thawed." *

Notwithstanding that great authority, it is well known to practical horticulturists that the pernicious consequences of severe cold on growing plants may to some extent be obviated by careful and gradual thawing; in such cases the freezing is incomplete, and does not involve all of the structures of the plant.

Haüy† thought at first that frost acts mechanically upon the tissues of plants, by expanding the fluids they contain, and thus bursting the cells or vessels in which they are inclosed. References might be multiplied to show how universal this opinion has been, and still is, among some of the best physiologists. Although most of them reject the idea of Hunter, they appear to be of the opinion that after complete congelation the plant necessarily dies.

H. R. Gœppert‡ was the first to prove, in 1829, that the changes which plants undergo, when they are killed by cold, do not consist of the bursting of their cells or vessels, but solely of an extinction of their vitality, which is followed by alterations in the chemical composition of their juices. In the winter of the same year Charles Morren made some experiments on the action of cold and frost upon plants, and arrived at the same conclusions deduced by Gœppert, although his theory differs in some respects from that of the latter author. The following are his deductions, from a more recent publication:§

1. That no organ whatever is torn by the action of frost, except in very rare cases, when the vesicles of cellular tissue give way to the action caused by the expansion of the liquid.

2. That the organs contained in the cellules, or the vesicles, undergo no alteration, unless perhaps in the case of the fecula, which in some circumstances is converted into sugar, no doubt in consequence of the action of some acid formed by the decomposition of the organic parts.

3. That the biforines do not cease the ejaculation of their raphides after freezing, and therefore it is probable that this movement is not due to a vital contractibility.

4. That the action of frost operates separately upon each individual elementary organ, so that a frozen plant contains as many icicles as there are cavities containing fluid, the dilatation thus produced not being sufficient to burst the sides of the cavities.

5. That such dilatation is principally owing to the separation of the air contained in the water.

6. That it is to be supposed that since the sap, the latex, the liquid of the cells, and all the fluids which are found in plants are not composed of pure water, vegetation by this condition resists freezing, within certain limits; as the experiments of Blagden have proven, the matters which taint the purity of the water allow the liquid to attain a degree of cold, while in their absence it would be frozen.

7. That the disengagement of air from water, during the act of con-

* Philosophical Transactions, 1775, vol. lxv. pp. 446–453, 1778; vol. lxviii, pp. 7–49.

† Traité elémentaire de Physique. Paris, 1806, vol. i, p. 259.

‡ Okens Iris, Breslau, 1830, p. 437, briefly abstracted: trans. in Edinburgh Journal of Natural and Geological Science, 1831, p. 150. Ueber Wärmentwickelung in der lebenden Pflanzen. Breslau, 1830. Wien, 1832.

§ Bijdragen tot de natuurkundige Wetenschappen, 1830, vol. v, pp. 55–77; Bulletin de l'Académie des Science de Bruxelles, 1838, vol. v, pp. 93–111.

gelation, is the most injurious of all the phenomena attendant upon freezing, introducing gaseous matter into organs not intended to elaborate it, and bringing about the first stages of decomposition in the sap and its precipitates, so that with a thaw commences a new chemical action destructive to vegetable life.

8. That the expansion of the cells and aquiferous organs drives a great quantity of water into the air cells and air vessels, so that the apparatus intended to convey liquid only contains water and air, while that which is naturally a vehicle for air conveys water. Such an inversion of the functions must necessarily be destructive to vegetable life, even if death were not produced in frozen plants by the decomposition of their juices, the loss of their excitability, and the chemical disturbance of all their contents.

After some experiments made during the winter of 1850–'51, Professor John Le Conte reached the conclusion that the sap of trees and shrubs which are uninjured by extreme cold *does become frozen* without the slightest damage to them; the reverse opinion being generally prevalent among the most eminent physiologists. Subjoined are his conclusions:

1. That the sap of certain plants can be readily frozen by the application of a comparatively moderate degree of cold.

2. That the congelation of the juices of vegetables does not, as many physiologists imagine, necessarily and inevitably result in the death of the whole plant, or of the part in which it takes place; but that, on the contrary, frequently no injurious consequences follow.

Professor Le Conte also thinks that "the hypothesis of the laceration of the vegetable tissues is totally untenable, for it seldom, if ever, takes place, even when the most succulent plants are frozen and killed by cold. During the process of congelation each cell of the tissue becomes individually larger by the increase of volume which attends the solidification of the contained fluid; but there is *no bursting*, because the membrane is extensible, and when thawed it recovers its first state by its elasticity. Although in some instances Professor John Lindley has found the tissue of the succulent parts of plants lacerated, as if by the dilatation of the fluid they had contained, yet this result was by no means an invariable concomitant of freezing, and it is not essentially connected with the destruction of vegetable life."*

Aug. Pyr De Candolle explains how plants endure the action of excessive cold, by the following facts, which may prevent their juices from freezing: 1. A certain amount of proper heat, generated by physiological actions. 2. The viscosity of the juices lowering the freezing point. 3. The distribution of the sap through minute vesicles and capillary vessels depressing the point of congelation still further. 4. The warmth of the ground from which the sap is pumped up. 5. The low conducting power of consecutive layers of bark, with entangled air included in their meshes, and of the wood itself, where the power is less transversely than longitudinally.†

Professor Lindley concludes that the fatal effect of frost upon plants is a more complicated action than has been supposed, of which the following are the more important phenomena: 1. A distention of the cellular succulent parts, often attended by laceration, and always by a destruction of their excitability. 2. An expulsion of air from the æriferous passages and cells. 3. An introduction of air, either expelled from the air passages or discharged from the water during the act of freezing, into parts intended exclusively to contain fluid. 4. A chemical decom-

*American Journal of Science, 1852, vol. xiii, p. 204.
†Physiologie Végétale. Paris, 1832, vol. iii, p. 1101.

position of the tissue and its contents, especially the chlorophyl. 5. A destruction of the vitality of the latex, and a stoppage of the action of its vessels. 6. An obstruction of the interior of the tubes of parenchyma, or woody fiber, by the distention of their sides. In another place Professor Lindley says:

> It has been suggested that the fluids contained in different species of plants may themselves act differently in the presence of cold, just as the oil of turpentine requires a temperature of 14° to freeze, while oil of bergamot freezes at 23° and olive oil at 36°. This may be true to a limited extent, but it does not explain the phenomena. The plant *x* perishes from frost, for instance, while another, identical with it in nature, lives with impunity within two yards of it, both having been exposed to the same temperature. The fluids of the two will be chemically the same, and yet the results are opposite; except it would be in proportion to the quantity of water they contain, but not as to the quality of their fluids, that they have the power of resisting cold. Some plants are also killed by cold although their cells are perfectly empty, in which case we need not say that the expansive force of frozen fluid could have nothing to operate upon. All the experience that forty years' acquaintance with such phenomena has given us leads to one, and only one, conclusion, which is, that the power of resisting frost is the consequence of *specific vitality*, and of nothing else. It may be asked, what is this specific vitality? To that we have no reply to give, except that we do not know.*

As stated heretofore, Gœppert had already advanced the idea of the extinction of vitality in plants, followed by some chemical decomposition of their juices, by the action of frost upon them. At the same time Morren had shown the pernicious influence of air in the cells of their tissues as being the probable cause of that decomposition. Based upon these two conclusions, and on his own experiments, Hoffman has given the most satisfactory explanation concerning the action of frost upon plants, as shown in the following investigations of that conscientious observer:

During the winter of 1855, when the thermometer descended as low as 27°.7 C., Herman Hoffmann made numerous observations upon the influence of frost on vegetation. The most frequent frost did not notably change the aspect of the plants which it reached; they grew stiffened, often almost brittle; frequently they contracted some little, but their color sustained no important alteration. It made little difference with the tenderer plants whether the frost was 12° or 24° below zero for half an hour, or for twenty-four hours or more, providing it was not interrupted an instant by an elevation above zero, and that it penetrated into all their organic substances. In other rare cases the frost considerably changed the aspect of the plants, which result we may not foresee by the consistence of their leaves, their native country, their age, &c. The epidermis was detached in plates from the green parenchyma of the leaves without tearing, and presented the appearance of blisters raised on the skin by a burn, appearing to be filled only with air. The action of frost often changes the normal position of the organs. Hoffman saw the scented tulip bent and straightened more than ten consecutive times, according as the temperature fell below or rose above zero.

All plants do not support the alternations of freezing and thawing; a very great number are killed by the thaw, and not, as ordinarily thought by the frost; such are the tropical plants. The delicacy of a plant, and the quantity of juices which it contains do not furnish any sure indication of its sensibility to the frost. The delicate crocus, for

*Transactions of the Horticultural Society, London, new series, vol. p. 308, abstracted by Professor A. Gray in the American Journal of Sciences, 1840, vol. xxxix, pp. 18–28. The Theory of Horticulture, New York, 1859, p. 85. The Magazine of Horticulture, 1855, vol. xxi, pp. 391–394.

example, perhaps freezes to the point of being filled with crystals of ice entirely without injury. The reverse is observed with some plants apparently very strong, like the *acacias* of New Holland, which are very susceptible to the frost. In the other plants the quantity of water contained in their cells may serve as an indication. The wood of the same species of tree admits also of different conditions in spring, according to the state of the juices which it contains. The almond tree, situated in a sheltered position, and exposed to the sun, frequently perishes, while that planted upon the slope of a hill escapes from the frost. Sheltered positions, which are in summer and autumn favorable to the development of fruit, are disadvantageous in spring, on account of the acceleration which they often impose upon vegetation. At the close of the winter of 1854–'55, thousands of almond and peach trees perished by the frost in the neighborhood of Frankfort, and those in the enclosures sheltered from the north, and uncovered toward the south, suffered the most. The same fact was observed at Giessen.

Hoffmann says there does not exist any general rule by which to fix in advance the point to which a plant, or an organ, will resist the frost. We have for guidance in this regard only isolated observations. We cannot explain why plants, or parts of plants, sometimes delicate, and sometimes solid, do not suffer from the frost. But Hoffmann believes that he has proved why certain plants do suffer. I give his theory.

If we expose the leaves of rosemary, camellia, &c., to a cold of from 10° to 20° C. below zero, we do not remark any alteration at the end of several days; but if the sun touches the leaves in such a manner that their temperature is elevated for one moment above zero, so as to cause thawing, they undergo the most considerable alterations; the plants fade with all the symptoms of being entirely withered, and the leaves appear dry in a temperature of 50° to 68° C. above zero. The same phenomenon is produced when we place the frosted leaves in an enclosure without the sun, and where the temperature is only six-tenths of a degree above zero; thus the rapid increase of temperature is not the sole cause of these alterations. We may save parts of plants which are frozen by the sprinkling of cold water; it has been believed that this effect is due to the slowness of the thaw thus produced, but this opinion is erroneous, for the water renders the same service when it is warm. Hoffmann has several times observed that the leaves of *Camphora*, *Aucuba*, *Viburnum tinus*, camellia and rosemary, when carried after their freezing into a temperature of + 12°, were immediately discolored; but, having first been submitted to a cold of 18° to 28° C. below zero, and then entirely plunged in water of 12° above, they were preserved perfectly green for twenty-four hours; if, however, any part of these leaves emerged from the water, they turned completely black. This remarkable action of the water, independent of its temperature, obliges us to seek another explanation of the cause of this phenomenon. Here is Hoffmann's theory:

The freezing disengaging the air dissolved in the water, a given volume of the liquid containing air in dissolution will occupy less space when this gas has escaped; moreover, the water, dilated by freezing, having ten volumes of liquid, will give eleven volumes of ice.* For

* Galileo had concluded that the ice which floats upon the water had become dilated by freezing. The Florentine Academicians were willing to verify this assertion by varied and conclusive experiments; they certified that the volumes of liquid and solid water were to each other as 8 to 9, a relation but little different from that of $\frac{1}{1}\frac{0}{1}$, which has since been found to exist.—Comptes Rendus de l'Académie de Paris. 1870, vol. lxx, p. 1150.

these two reasons, when the fluid which fills a cell congeals, the cell is found distended beyond measure, without, however, bursting in the generality of cases. The elastic membrane of vegetable tissue thus distended loses its elasticity to such a degree that many days of repose are afterward necessary for it to regain its original dimensions after the melting of the ice. Now, when we carry frosted plants into a warm place, the ice which the cells contain being melted, the water will return to its primitive volume smaller than that of the ice; but the air which the freezing has disengaged will prevent the cellular membrane from returning to its first condition. We find, therefore, in the cells of plants which have been thawed the *water* and the *air* remaining separately, the one next to the other. This air is not long in producing an injurious influence on the chlorophyl, or green, of the leaves, and killing that part. Hoffmann compared the action of this gas in the cells of the leaves to the rapid mortal effect of the presence of bubbles of air in the blood of animals. The method of preserving the chlorophyl and the organic matters from the injurious influence of the air consists of allowing the penetration of cold or warm water into the cells at the same moment when the vesicles of gas, which are retained between the needles of ice, become free by the fusion of the water, and commence to unite; then, as long as this air does not form a stratum, lodged between the water and the walls of the cell, it cannot cause the decomposition of the chlorophyl. Being free it dissolves little by little in the liquid, or escapes gradually to the exterior by the vessels of the plant.

When, rarely enough, frozen plants which are thawing very slowly to a temperature near that of melting ice escape death, it is because the disengagement of the air from the ice takes place very slowly and in such a manner that the vegetable membrane has time gradually to regain its original volume by its elasticity.

To sustain this opinion on the cause of the death of plants by frost, Hoffmann reports a number of observations, from which it results that the leaves always diminish in volume when they freeze; in the jonquil, for instance, the leaves diminished in freezing 21 parts to 100, or nearly one-fourth. This diminution of volume is always recognizable at first sight, and is produced with such rapidity that it is the same after ten minutes of freezing as after ten to thirty hours. Hoffmann believes that it is due in part to the fact that the air becomes free by the freezing of the cellular juices, and escapes from the leaves.

But how can we reconcile this remarkable diminution of the frozen leaves with the fact that the cells increase in volume by the freezing of the water, and by the disengagement of the air contained in it? Hoffmann believes that this increase is more than counterbalanced by the contraction of the epidermis, experienced through the entire leaf, (which thus becomes very tough and consistent,) and the presence of the air existing in the vessels and the intercellular spaces. The enlargement of the cells operates interiorly altogether, and at the expense of the vessels and spaces which oppose less resistance than the enveloping epidermis.

If, says Hoffmann, this explanation of the process which causes the death of frozen plants is really the true one, we may probably deduce from it the aptitude of certain plants for resisting the frosts. They appear to owe this property to the membrane of their cells, which possesses an elasticity sufficiently energetic to enable them to resist the distension produced by the action of the frosts, and to recover their original dimensions as the ice again becomes water, in such a way that the disengaged air is forced to dissolve rapidly under the pressure exer-

cised upon it. This author cites, for example, the lilac, because its elasticity is very remarkable.

When plants die only after having endured the action of cold during several days, their destruction is not owing to congelation, but more to the arrest of nutrition and transpiration. Finally, Hoffmann remarks that in the observations on the degree of cold to which plants may be submitted, it is necessary to beware of concluding from the temperature indicated by the thermometer that which the plants can support, because their exposition and their radiation may considerably modify their thermal condition. After his observations on the barley, the flax, and the water-cress, it resulted that the same plants may be affected in different manners, relative to the frosts, at different moments of their existence. He specifies, as a fact worthy of remark, that constantly all or nearly all the stalks, proceeding from one seed-plot, are affected in the same manner by the frosts, while they support its influence in different ways when they proceed from different seed-plots of the same species. Sometimes the young stalks are most sensitive to the action of the cold; sometimes, on the contrary, the oldest suffer most; and then, again, the tallest are affected most readily.*

DIFFERENT METHODS FOR PROTECTING PLANTS FROM FROST.

For protecting the plants of warm countries from frost, Thouin has employed several methods with success. The first consisted of placing these plants in inclosures and shelters from strong light, the day of the frost, and some moments before the appearance of the sun. Plants which had passed a very cold night in the open air, and whose leaves, covered with white frost, had become stiff and brittle, thawed very slowly, and did not experience the accidents which occurred to the same species of plants not placed within these shelters.

The second method consisted of showering the frozen plants, using a watering-pot for the small ones, a skimmer-syringe for shrubs, and a hand-pump for large trees in boxes, the elevation exceeding fourteen feet. He sprinkled only at the instant when the first rays of the sun, which were very brilliant the first two days of the frost, began to fall upon them. The water, less cold than the air, in melting the frost which covered the leaves, prevented the injurious effects of the rays of the sun; but if the plants were sprinkled before the rising of the sun, the water congealed on them and increased the intensity of the cold. The leaves of some trees with large tops, which were in the shade at the instant of the sprinkling of the water, were covered with a slight layer of ice, which thawed only after some hours. All these leaves and branches grew yellow or blackish at the end of some days, and afterward fell off entirely.

The third method consisted of interposing between the plants touched by the frost and the rays of the sun a thick cloud of smoke. At various distances in the vicinity of the plants, and above the reach of the wind, were established piles of half-dry grass, damp leaves, or partly ground manure, which were fired as the sun was about to appear, and sustained until the frost melted and the water which was produced fell at the foot of the trees. The effect of this mode of thawing will be more prompt and sure if the smoke is carried by the wind directly upon the trees, which result is desirable, but not indispensable; for it suffices if the rays of the sun are broken, or obscured, so that they do not act upon

* Witterung und Wachsthum, oder Grundzüge der Pflanzenklimatologie. Leipzig, 1857, 8vo.

the brilliant facets of the ice-crystals which cover the plants. For the preservation of wall-trees, orchards, trellis-plants and vines, nets, canvas, straw-matting, and dry leaves may be employed with success. For the purpose of arresting the progress of the injury received by frozen plants, it is necessary to remove the leaves, and cut off, even to the quick, all the shoots and branches which have been affected. This operation should be performed with a very sharp instrument close to where the bud springs, and a little above, in order that the shoots, producing the eyes which attract the sap from its legitimate course, being promptly cicatrized, there is no wound occasioned by the suppression of the frozen branches.*

An able gardener, Mr. Charles Harrison, has given the following method of watering peach and nectarine trees to preserve them from the effects of frost: Before the sun is up, after a frosty night, if he finds that there is any appearance of frost in the bloom or young fruit, he waters them thoroughly with cold water from a garden engine; and, even if they are discolored, this operation recovers them, provided it be done before the sun falls upon them. He has sometimes watered particular parts of the trees more than once in the same morning before he could get entirely rid of the effects of the frost. The fact that the operation of watering, in counteracting the frost, produces this effect only if it be done before the sun comes upon the blossoms or young fruits, seems to be analogous to the condition of a frost-bitten joint or limb, which is recovered by the application of cold water, but injured, and sometimes destroyed, by being brought near the fire, or within the influence of sudden warmth. Harrison first discovered this method by the following accident: In planting some cabbage among some rows of kidney-beans, very early on the morning after a frosty night in spring, and before the sun was high enough to turn upon the frosted beans, he spilled upon them some of the water which he had used in his planting, and, to his surprise, he found that the beans immediately began to recover. This method was adopted by Thouin in 1806, and has been followed by many other horticulturists up to the present day.

Harrison protects his trees from the frost in the month of January by branches of broom. These are previously steeped in soap-suds, mixed with one-third of urine, for forty-eight hours, to clear them from insects, and then they are disposed thinly over the whole tree, and allowed to remain only until the tree begins to break into leaf. Nevertheless, his success did not depend entirely upon his watering, but a great deal upon his pruning and dressing in the following manner: The peach and nectarine trees are pruned and nailed in December and January, when he always takes two-thirds of the young shoots away. In two hand-dressings, in May and July, he leaves the lowest and weakest shoots for a succession in the year following, pinching off the leading and other shoots.†

Mr. James Mean has adopted the following method for preserving fig-trees in winter: In autumn, as soon as the leaves are off, the branches are unnailed and brought down to the ground, which is opened to the depth of nine or ten inches close to the wall. In the trench thus made the branches are laid, and covered with a light red sand to the thickness of two feet, which is sufficient to exclude all frost. About the middle of April the sand is removed; the branches, being then well washed, are again nailed to the wall, and never fail to produce a crop. He always

* Annales de l'Agriculture Française, 1806, vol. xxv, pp. 315–319.
† Transactions of the Horticultural Society of London, 1818, vol. ii, pp. 13–18.

propagates a proportion of young wood every year, and does not suffer any to remain on the trees older than six or seven years.*

In 1820 the sudden change from a temperature of 12° above zero to one of 14° below, destroyed, in January, the greater part of the olive trees in Provence, France. Mr. Joseph Jean, proprietor of an olive-orchard of one hundred trees, by a process which he invented, saved seventy-six of the oldest. In the month of April he cut all the branches within some distance of the top of the trunk; he smoked the trees in the ordinary manner, and buried fresh herbage at their feet; he then cut off all the sprouts which were manifested at the ends of the remaining branches. The new sprouts of the first year grew to one meter, or about three feet, and redoubled their growth in the second season. In the third year he had already regained a quarter of his accustomed harvest. Raibaud-Lange has given the following explanation: The sap of the partly-frozen trees, maintained abundant by the dampness of the herbage and the suppressing of the sprouts springing from near the roots, is forced to flow upward into the trunk, and the tree is thus saved from the injurious effects of the frost.†

The distinguished horticulturist, Mr. Thomas Andrew Knight, says:

Among the various methods of protecting the blossoms of wall-trees from frost, which are adopted by gardeners, it must be admitted that the most efficient are those by which the trees are thickly covered during the night, and fully exposed during the day; and if this kind of protection be given to peach and nectarine trees very early in the spring, it not only preserves the blossoms, but it also prevents the appearance of blistered leaves, which are generally abundant in cold and unfavorable seasons. Woolen nets, or a patent imitation of netting, constitute the best material for wall-tree covering; but the meshes should be sufficiently wide to permit the ingress of bees, for the pistils of the blossoms of almost all fruit trees are not in the best state to receive the pollen till the anthers of these blossoms have been expanded, and the number of blossoms which are rendered productive of fruit by their own proper pollen is not, I have reasón to believe, very great. The exclusion of honey-gathering insects is consequently in most cases very injurious.

The material which I employ consists of small branches of the birch-tree, about two feet in length, collected as soon as the leaves have become full grown, at the end of June; these are preserved under cover till the following spring, when they have become perfectly dry, which is a very important circumstance. They are then secured to the walls by a few nails and shreds, with their points hanging perpendicularly downward, their upper and thick ends being in contact with the wall, and the opposite slender extremities projecting eight or ten inches from it. This position of the covering material appears to me to be an extremely advantageous one, and I have constantly employed it in this manner more than ten years. Every year a very large portion of my blossoms has escaped injury under its protection. As to the quantity to be used, with advantage, it is left to the discretion of the gardener. If the situation of his garden be low, he may cover his trees more closely than if it be high; but the covering should never be so thick or close as to prevent a large portion of the blossoms being visible to a person passing within a few feet of the wall; under such circumstances almost every blossom will in some part of the day receive a portion of the solar rays. As the danger to be apprehended from frost diminishes, and the quantity of young shoots and foliage increases, the covering material should be taken away at successive periods and in small quantities. My experience has been confined to the use of the slender branches of the birch-tree, but bunches of other trees with small leaves, such as the hawthorn or hornbeam, might, I believe, be employed with success, though I give decided preference to those of the birch.‡

Jæger has obtained the greatest success by the use of well-water for sprinkling frozen plants, but it is necessary to apply it when the thermometer stands about 1° below zero,§ because if we sprinkle the plants

---

* Transactions of the Horticultural Society of London, 1818, vol. ii, p. 228.

† Mem. d'Agriculture, Paris, 1823, pp. 407–36; Annales de l'Agriculture Française, Paris, 1823, vol. xxii, p. 355–83; Remarks of H. Laure, in Bulletin de la Société d'Agriculture du Département du Var. Draguignan, 1824, No. xv; Report of Boscip, in Annales de l'Agriculture Française. Paris, 1823, vol. xxii, pp. 383–86.

‡ Transactions of the Horticultural Society of London, 1824, vol. 5, pp. 505–8.

§ Centigrade, equivalent to 32° Fahrenheit, or freezing point.

below this temperature, the water produces an opposite effect, increasing the degree of cold; and if above, the water will not have any effect, for the elevated temperature will already have exercised its baleful influence. Jæger believes this method applicable on a large scale to the vine-growing countries, where the spring frosts are calamitous; simple hand-engines, placed at various distances in the plantation, will afford the surest guarantee against this scourge.*

A horticulturist made cuts in the bark of a young nut-tree injured by the frost. The bark thus treated assumed a darker tint, and a thick liquid, resembling the juice of boiled fruit, exuded from the trunk. He removed the bark, and even entirely stripped some trees from near the root up to the healthy branches, and then rubbed the trunks with liquified clay. This operation arrested the escape of the thick liquid, the bark quickly reformed, acquired in a short time the thickness of a line, and the tree in the same year put forth strong branches. Those trees which had not received the same treatment died.†

It is asserted that, if a fruit tree be enveloped with straw or hempen ropes, and the lower end of the rope be put into a tub of water, the tree will not be injured by the frost.‡

Another horticulturist has for three years made use of a net-work prepared from the filaments of Spanish broom, (*Spartium junceum*,) for sheltering espaliers from the frost. The nets were placed obliquely against poles, of the height of the walls, and at a distance of about three feet from the espalier. They served to break the force of the cold winds and the beating rains, and to neutralize the effects of the frost. The morning after a frost these nets, viewed horizontally, showed each mesh armed with needles of ice, which melted in the first rays of the sun. Trees protected in this way did not suffer from those first frosts which are so pernicious to vegetation. This shelter unites all the benefits of air and warmth, and the fruits produced under it are excellent and of remarkable size.§

Chateauvieux does not advise the immediate cutting down of branches which the frost has affected, and which are supposed to be dead. Descending below the parts completely destroyed by the frost, as far as those cells which have not been injured, the disorganization gradually diminishes. The power of vegetation may, for this reason, be reëstablished to a degree more or less elevated, according as circumstances are more or less favorable. This author has seen, in the middle of the summer, the branches of a fig tree apparently injured beyond any hope of vegetation, but which, through neglect, had not been cut off, putting forth in a surprising manner. The plum trees of Portugal, the *Coignassiers* of Japan, the laurel, &c., have given, some time after freezing, indications of vegetation in their higher branches. The above precaution favors the recovery of certain trees which sprout again on the old wood with difficulty, and also diminishes the evil that heavy rains occasion to the trees. It is not necessary to cut down to the quick in these cases; a little wood should be left above it to prevent the air from coming in contact with those parts from which we may expect new shoots, and which at first are in danger of becoming dry on account of their diminished force of vegetation. In two cases only will this precaution prove injurious; first, where the frozen parts contain foul juices which are likely to attack the healthy portions; in this case it will be neces-

* Würtemb. Correspond. des Landwirths. Vereins. September, 1825, vol. viii, p. 139.
† Ann. Pomolog. d'Altenbourg, 1826, vol. 1, p. 232.
‡ Journal of the Franklin Institute, 1826, vol. 1, p. 173.
§ Annales de la Société Linnéenne. Paris, 1827, p. 145.

sary to hasten the cutting away of the damaged branches; and, second, if the disorganization has attacked the large branches and the trunk, the latter must be cut below the level of the soil; the earth which covers the spot, sheltering it from the contact of the air, will preserve by its dampness the suppleness of the woody fibers, and protect the young shoots as they spring from the rays of the sun, which might destroy them in a short time.*

Kottwitz proposes to turn the stocks of vines gently toward the ground, and to cover them with leaves as dry as possible. To prevent the wind from carrying away these leaves, they should be overlaid with the refuse vine cuttings, bean-stalks, and ends of boards, and surrounded with small pickets. Vine stocks thus covered are entirely sheltered from the frosts of winter; and, as the air penetrates in spite of the leaves, the development of the sap is prevented, and takes place only when the stock is straightened and pruned. By following this method all loss of sap is guarded against, and the vine entirely escapes the pernicious influences of the frost and the hoar-frost. Combining with this process the pruning in autumn, which is preferable to that of spring, we attain marked advantages.†

A horticulturist established trellises six inches from an espalier wall, and eight inches from each other, and attached the trees to them in the beginning of April; the trees thus removed from the wall suffered less from the frost than when at the distance of two inches only, and they also received more nourishment in summer. This measure is especially serviceable for apricots. In those countries where wood is scarce, the trellises may be made of iron wire.‡

Margat affirms that we may transport fruit trees with bare roots, and without packing, during the most intense frost, provided they have been taken up twelve or fifteen days before the frost and exposed to the air, with their roots on the ground during all this time. But the roots of trees exposed to the frost immediately after being dug out of the ground always perish. Trees thus recently taken up, although well packed, are liable to have their roots frozen upon arriving at their destination, if a frost occurs upon the way, while those whose roots have been previously exposed to the air for twelve or fifteen days always arrive in a good condition, even without packing. The experiments of Margat are confirmed by those of the same nature made at Neuilly by Jacques.§

Louesse suggests, as the best means for sheltering espaliers from the later frosts, a loose frame covered with oil-cloth prepared with a thick layer of linseed oil on each side, and even on the wood. When, in the first fortnight of February, the flower-buds of apricot trees begin to enlarge, this frame should be placed as close as possible to the trees, and perpendicularly to the wall, taking the precaution that it does not touch the branches; it should be maintained in place by wooden supports fixed in the wall, and the sides guarded by moss, horse-litter, or any other substance capable of intercepting the exterior air.

Flowering takes place under the shelters with greater rapidity and facility, because the action of the solar rays is strengthened and the warmth preserved for a long time. In this sort of hot-house, we see almost the entire quantity of fruits mature perfectly, and the effect of the

---

* Bulletin de la classe d'Agriculture de la Société des Arts de Génève. 1829, 3me année, No. 36, p. 185.

† Verhandlungen des Vereims zur Beförderung des Gartenbaues in den Preussischen Staaten, vol. 5, p. 83.

‡ The above, vol. iv, p. 300.

§ Annales de la Société d'Horticulture. Paris, 1830, p. 41.

dampness, the frost, and scorching by the sun are no longer to be feared, as in the case of those trees in the open air. When the warmth increases as the season advances, it becomes necessary to give more air to the trees by raising the trap-net at the bottom, or removing the straw which protects the sides. The whole may be entirely dispensed with only when the temperature causes no more fear. It will be found expedient to leave the frames as long as possible, because they greatly advance the growth of the fruit.*

Pépin has succeeded, by the suppression of leaves before their natural fall, in saving the delicate slips from the effect of the frost. Thouin has obtained the same results by the suppression of the fruits of the second season on fig trees. According to Bonafons, the first practice is habitually applied in Sweden to most of the woody plants, and also in Piedmont to the mulberry tree. According to Puvis, those trees which are not stripped by the worms, and whose harvesting is consequently more normal, are better defended than those whose summer stripping forces a second sprouting in the same season. According to Saubiac, in Ariege, France, the best preventive of the injury by the later frosts upon the vine is a late pruning, which arrests the development of new buds.†

Another horticulturist proposes the following method for protecting shrubs and young trees from the frosts: Two half cylinders are formed of wood, as if to be covered with wicker-work, but, instead of being thus completed, they are plaited or woven over with the material of which bee-hives are composed. These half-cylinders have strong legs attached, which are thrust into the ground, and where the design is merely to shelter the plant from the east or northeast wind, only one is placed on the side to be protected; but where the shrub is tender and requires more complete shelter, two are placed together and fastened to each other with hooks; over them is placed a cover, and thus is formed a protection more complete than any formed of other materials, and more efficacious against the frost. These cylinders are comparatively light, easily applied or removed, and exceedingly warm, for scarcely any frost will penetrate them, so completely do they prevent the escape of the heat which arises from the native warmth of the earth. If the ground be hard, holes may be made for the supports with a crow-bar or the point of a pick, but in most cases a pointed stake of any sort may be used; and when the covering is properly placed, so as to be close to the ground, some loose earth may be put around the bottom to prevent any air from getting under it. The earth should also be closed around the legs by ramming, in order to fasten them down.‡

An experimenter says that in protecting pits and frames, the covering, if placed on the glass, absorbs the heat; but if located at a short distance above the glass, it radiates the heat, and keeps the external air from acting on the frame at all. Now, nothing can be more obvious than the following conclusions: If the radiation of heat from cloth, which touches nothing, will keep the external air from acting on the frames at all, it will prevent the external air from acting upon anything else; and this is sufficient to satisfy us that cloth prepared with transparent varnishes, and used instead of glass, must be efficient as a means of protection; and I am even inclined to believe that its advocates are right in saying that it is more effective than glass. In regard to the question of light, as we are always shading in bright weather, so for

* Annales de la Société d'Horticulture. Paris, 1843, vol. xxxvi, pp. 247–250.
† Annales de la Société d'Horticulture. Paris, 1840, vol. xxvi, pp. 8, 9.
‡ The Gardener and Practical Florist. London, 1843, vol. i, pp. 285, 286.

many purposes the cloth must be better than glass, because it requires no additional shading. This covering confines the heat, and prevents the operation of the external air, so that if the frames are closed when there is no frost, it likewise prevents the escape of the heat, and keeps the covered subjects at the same temperature which prevailed when the frames were closed.*

Mr. R. Thompson, of England, describes the following method of protecting espaliers in unusually severe weather, peaches and nectarines being in bloom at the time. At the end of March coping-boards were placed along the walls, and a network stretched over half of it, while straw screens protected the other half at night; in severe nights the nets were the best protection. The screens consisted of one length of straw fixed on twine, and stretched between training rods one inch square and six feet long; they were kept in place by fixing the tops of the rods against nails in the wall, the lower-pointed ends being inserted in the ground. By day the screens were rolled and laid at the bottom of the wall. The blossoms under these were protected, but those on the front of shoots above them were destroyed. Some of the latter, which were on the side of the shoots close to the wall, derived from it sufficient heat to keep them alive. On the whole a fair crop was saved. On pear walls the blossoms were abundant and mostly expanded. Coping-boards were used, in addition to nets, for walls with an eastern aspect. Elsewhere straw screens were projected from the tops of the walls. Under these the fruit on the upper branches, near the straw, was saved, but that toward the bottoms of some trees was much injured. The crops averaged fair. A glazed peach frame was covered with mats, but still the blossoms were mostly destroyed.

The preceding observations show that straw screens will protect peach trees in blossom from the effects of 12° of frost; coping-boards will suffice for about 4°; common nets, aided by coping-boards, were not so efficient as straw screens. Sashes placed nearly horizontal, covered with mats, with a three-inch opening at the bottom of the frame, and perforated zinc-plates in front, were insufficient, the fruit under them suffering as much as that on an open wall with coping-boards only. Straw being a very efficient material, probably from its hollow nature, and the quantity of air it contains, and also being a slow conductor of heat, should be manufactured in neat screens, so as to preserve its tubular form.†

The following is Mr. John Harrison's method for protecting wall fruit: A rod is placed horizontally under the coping of the wall; another is fixed on posts three feet from the bottom of the wall, and eighteen inches from the ground, and the two are connected by braces. A covering is prepared by sewing woolen netting on its upper and lower edges to coarse calico, and this is attached to the rods by tapes. The cost of the net is 1*s.* 8*d.* per yard; of the calico, 2*d.* or 2½*d.* per yard, and each yard, slit down the middle and sewed to the netting, makes the covering three yards wide; the tape and poles are a small item, and the entire cost in England, including making, is under 2*s.* per yard.

Harrison's walls are brick, eleven feet high, with a stone coping of two inches projecting on each side. His trees are unnailed before winter, and fastened loosely to the wall to prevent their being broken by the wind. They are kept thus until ready to burst into flower, the object being to retard vegetation as much as possible. They are dressed with the following composition: equal parts of sulphur vivum, Scotch

* The Gardener and Practical Florist. London, 1844, vol. iii, pp. 378, 379.
† Journal of the Horticultural Society. London, 1852, pp. 207, 208.

snuff, and unslaked lime, the whole sifted fine; adding a half quantity of lampblack, and mixing with urine and soapsuds to the consistency of thick paint. Old and young wood are dressed with this compound, with a painter's brush, after the trees are pruned, and they are then nailed, all from the upper side of the leading branches.

Harrison's walls are flued, but fire is used only to ripen the fruit in succession if required, and, in a very wet season, to ripen the wood after the fruit has been gathered, but never in spring.

The advantages of this netting are very great. Harrison's walls contain eight peach and eight nectarine trees. The netting is fixed and removed in two or three hours; it is put up when the blossoms can no longer be retarded, and remains until the end of May, when all danger from frost is over. The gardener can readily work under it. There are no blistered leaves, and the first shoots always ripen their wood, insuring fruit for the following year. In 1854 these trees ripened over one thousand dozens of fruit, and the yield has never been less since netting has been used. The fruit was thinned early in June, when three hundred dozens nectarines and fifty-four dozens peaches were removed—young fruit, of full size—and further thinning was requisite after stoning.*

Etienne Pro suggests the following process for sheltering vines in espalier, and even in vineyards, from spring frosts: Take about ten bushels of wood ashes, or others, to forty acres of vineland; let them be well dried and sifted, and, on the evening before a frost is expected, strew lightly over the vines and the ground. The ashes thus sprinkled on the earth absorb the dampness, and also cover the new sprouts and protect them from the action of the sun. This action has upon the young shoots already struck by the frost the same effect as fire upon members frozen by the cold. The vine-bud, or the young sprout, covered with ashes, is not injured by the frost, or burned by the sun which strikes it afterward, and it returns without suffering to its primitive state. The operation of sprinkling the ashes could be repeated early in the morning, if the frost were persistent; and if the ashes should be washed away by the rain they should be renewed. During three years Pro employed this process to cover eighteen hundred meters of vines in the midst of the fields; they met with no damage, while, under the same circumstances, those of his neighbors were completely frozen.†

The great object, says "B. M.," in the recovery of plants from the effects of the frost, is to remove the frozen condition as gradually as possible, and to guard them against sudden exposure to heat, and from the direct influence of the sun. In plant-houses this can be effected by shading the roof, and by syringing the plant with very cold water, taking care, at the same time, that no more fire-heat is present than is sufficient to raise the temperature of the house a very few degrees above the freezing point. This last observation is very important. For outdoor trees and plants, when frozen, shading is perhaps the best method within our power to adopt, at the same time causing the thaw to take place as gradually as possible. When they are covered with snow their condition is most favorable; but with tender plants it would be well to cover the snow upon them with straw, or mats, so that the sun may not act directly upon it, and the thawing process may be thereby rendered more gradual.

Much diversity of opinion exists among practical men as to the advantage of protecting, by straw or other covering, tender trees and

* Journal of the Horticultural Society, 1855, pp. 205–207.
† Journal de la Société d'Horticulture de Paris, 1860, vol. vi, pp. 265–266.

shrubs in open grounds. Where the risk is slight it is preferable to incur it rather than to use covering; but where the plant is unquestionably tender there is no alternative. For deciduous plants, straw bound neatly around them is as good and as unobjectionable as any method. For evergreens an old barrel or wooden structure is best.

When out-door coverings are used they should not be removed too early in the spring, because the plant will be more susceptible to changes of temperature than if it had been wholly exposed to the action of the weather.*

The editor of the Horticulturist says: "We indorse emphatically B. M.'s treatment, because we have tried it many times with entire success." In regard to out-door plants, more injury is sustained from too much covering than from severe weather, and often plants are covered which do not require protection."

Mr. E. Alesworth, of Peterboro, New York, was in the habit of using boxes, casks, pails, pans, and cloths to protect plants in frosty nights. One very cold night he covered one plant with a basket; in the morning nearly every other plant was killed. It is well known that if, on the approach of a frosty night, the wind still continues to blow, there is not frost enough to do much injury; but if the wind goes down with the sun, and is succeeded by a calm, the consequences are very severe to young flowers and garden plants. Any covering only upon the sides or ends will create a draught in the stillest night; and this was the case with the basket. Alesworth has ever since placed boxes, &c., at intervals, and laid boards on the top of them, leaving both sides wide open, and he never loses a plant. †

Mr. J. Griffith states that the action of frost in lifting fence-posts from the ground may be prevented by casing the lower ends of the posts with boards, or, far better, with tile of the right size. This casing will be affected by repeated freezing and thawing, but the posts will remain unmoved.‡

INFLUENCE OF THE COLOR OF WALLS UPON ESPALIERS.

The cultivators of trees believe that the coloring of walls increases the heat received by espaliers, or wall trees. A black wall gathers more heat, by the absorption of solar rays, than one painted white, which reflects these rays; a black wall would therefore be preferable for vines and trees bearing fruits with stones, which require a tolerably strong heat; whereas, a white wall would be most suitable for the trees which bear fruits with seeds.

The principle is correct, but the conclusion is erroneous, for the real action of the coloring of walls upon espaliers is not yet well known. If the hand be placed against the wall, the contact differs from that which the tree sustains in a similar position, because between the latter there is always an interval of some centimeters through which the air circulates freely. A white wall warms less than a black one, because it reflects readily the caloric which the latter absorbs. Also, the stratum of air lying nearest a white wall, receiving the same quantity of direct rays, in addition to the reflected ones, is found to be warmer than if the wall were black. It is precisely in this stratum of air lying nearest the wall that an espalier grows. Accordingly, the white color of a wall should increase the warmth which is received by espaliers, while a black hue would tend to diminish it.

* The Horticulturist. New York, 1860, vol. v, p. 134.
† Transactions of the American Institute for 1864–'65, p. 100.
‡ The Prairie Farmer, Chicago, 1866, vol. xviii, p. 365.

During the night the influence of the coloring of walls differs from that exerted during the day; then, especially after midnight, an equal temperature prevails before walls of opposite colors, and also in the stratum of air which circulates upon their surfaces.

In sixty-one observations made between 9 a. m. and 3 p. m., Vintry* found the thermometer higher before a white than before a black screen. The more brilliant the sun the greater was this difference. The range was from 2° to 3°, and reached even as high as 5° Cent. He made use of bitumened paper, one washed over with lime and the other with gas tar.

An exception to this rule is found when a cold wind paralyzes the action of the reflected rays and causes an accidental coolness; in this case the excess of caloric accumulated in a black wall might exercise some effect upon the air near its surface. Following this hypothesis, it would seem desirable to color and even to blacken walls for trees bearing seeded fruits, which shun a temperature too elevated.

If the facts here presented are correct, it is possible that there still exists a mass of circumstances which should be taken into consideration. Heat and light do not produce the same effect. In cloudy weather a black wall may heat a great deal; is it the same with a white one? What action attends a current produced along garden walls struck by the sun, which arises only from air traversing the surface of the ground? The nature of this surface, the special plants which cover it, and its dampness or dryness, may also exert some influence. The black wall being warmer at sunset than the white, communicates during a part of the night more heat to plants trained against it. It retards, perhaps, the moment when these plants become colder than the air, and when the deposit of dew affects the surface of the leaves. Is this result favorable or unfavorable? Is it of the same nature during spring, summer, and autumn, and equally favorable in every season?

Able horticulturists assert that terrace walls which closely press the ground on one side, are less favorable support for espaliers than those which are exposed to the air on both sides. A French writer thinks that, if this be true, it would be consistent that a terrace wall presents one surface of only 10° or 12° below zero, and that in the other, receiving the solar rays, the heat which they tend to produce is constantly destroyed, or at least greatly diminished by the relative cold of the first-named surface. We may not compare the effect of a good wall, permeated on the one side with warmth from the sun's rays, and on the other by an air with a temperature of 25° or 30°, and which yields this heat but slowly during the night, to a sheet of pasteboard, as Vintry has done in his observations, for the latter, as soon as the sun clouds or sets, continues to receive the temperature of the surrounding air.

By covering the ground with charcoal-dust, dark-colored straw, the remains of heath or faded leaves, the maturity of certain plants is accelerated fifteen or twenty days, a result which is surprising. We observe an analogous fact when we place on the snow two pieces of cloth, one white and the other black; the former does not produce, properly speaking, any effect on the snow, even in a fine sunlight, while the latter quickly occasions melting, and sinks rapidly below the surface. Is not this effect somewhat similar to the opposite action of black and white walls?†

Wells‡ made experiments sufficiently decisive in this regard. During

* Journal de la Société d'Horticulture, Paris, 1857, vol. iii, pp. 480–483.
† Journal de la Société d'Horticulture. Paris, 1857, vol. iii, pp. 600–603.
‡ An Essay on Dew. London, 1818 and 1821; new edition, with annotations by L. P. Casella, and an appendix by R. Strachan, London, 1866, 8vo.

a serene night he stretched a handkerchief vertically over a meadow, by means of two sticks, and observed that a thermometer placed beneath it on the grass, and exposed to the wind, marked from 3° to 5° Cent. more than a thermometer placed near by but unprotected by the handkerchief. This experiment, says Arago,* shows that the walls of espaliers afford to the plants, and distribute to them at night, a little more heat than they have absorbed during the day, and also mechanically arrest the cold winds, acting like screens, and diminishing the great loss of caloric which the plants would have experienced by their radiation, if a great part of the sky had not been hidden from them by the walls.

We must ascertain by practical experiment what shape and composition of screens are most suitable for protecting wall trees and other vegetation from frost. Mr. R. Thompson has shown that different kinds of screens will protect, to a certain range of temperature only, some species of trees, but not others. For example, straw screens will protect peach trees in blossom from the effects of 12° of frost, while coping-boards will be sufficient for about 4°. We must, therefore, combine the circulation of air and the conductibility and radiation of heat with the form and quality of different screens.

PHYSICAL PROPERTIES OF DIFFERENT ARABLE SOILS.

The knowledge of the physical properties of soils is of the highest importance in agronomy and agriculture. It precedes the study of chemical properties, which are secondary and much more complicated. They are the only ones that the first agricultural authors have given as characteristic signs of the qualities of soil. Virgil, Varro, Columella, and other philosophers of antiquity mention them. The science being then in its infancy, these first essays had no application to agriculture. And still, at the present time, agriculturists judge in vain of the qualities of earths by their color, their relative moisture, their consistence, the appearance of their vegetation, &c. These indications, more or less vague, not reposing on any scientific basis, have, consequently, very little practical value.

The study of the physical properties of soils did not command the attention of savants until 1757, when they commenced the chemical analysis of soil. The first experiments were made by a Bernois savant, who limited his examinations to the weight of earth, and its facility for absorbing water. The celebrated German agriculturist, Thaër, paid great attention to the physical properties in his "Analyses of Earths;" but he did not submit them to a series of comparative experiments.

Christian L. Schübler, appointed in 1816 professor of physics and chemistry, applied to agriculture, at Hoffwyl, asked himself where was the science he was about to teach, and perceived that it did not exist. It was then that he studied for the first time agriculture as a physicist, and sought for the best means for determining and comparing the diverse physical properties of soils.† He discovered that the specific weight of earth was always in relation to its facility for retaining heat, and of drying promptly; that the facility for retaining water em-

* Annuaire du Bureau des Longitudes, Paris, 1828. Annales de l'Agriculture Française, Paris, 1827, vol. xi, p. 197.

† His researches appeared first in the newspapers of Hoffwyl; by abstract in the *Bibliothèque Britannique*. It forms the second section of agronomy in a German work entitled "Principles of Agricultural Chemistry, in more direct reference to the Economy of Agriculture and Forestry." Second edition, revised and improved by Professor Krutzsch. Tharaud, in Saxony, 1838, and in his German translation of Chaptal's Agricultural Chemistry.

braces that of absorbing the moisture and the oxygen of the air with rapidity, &c.

We have already stated that the physical properties of arable soils, and the physical influences of the atmosphere, have a greater direct action upon vegetation than those properties and influences purely chemical, because the first are anterior to and serve as a basis for the last. We proceed to corroborate this announcement by the learned opinion of the celebrated chemist and agriculturist, Boussingault, which proves how far this question is still in its infancy. He says:

At an epoch which is not yet very distant, it was believed that a close connection existed between the composition and the quality of arable soil. Numerous analyses soon modified this opinion by demonstrating that the mineral elements have not always the importance which is attributed to them. Schübler tried even to prove that the fertility of a soil depends a great deal more upon its physical properties, its aggregate condition, its aptitude for imbibition, &c., than on its chemical constitution. That which characterizes cultivable soil, whose base consists of disaggregated mineral substances, is the presence of organic remains more or less modified, such as humus and compost. Vegetable earth, properly called, results from this association. In regard to its intimate nature, we fear not to affirm that, in spite of its apparent simplicity, we have still a very imperfect knowledge of it. This absorbing faculty, as mysterious as unexpected, which the soil exercises on ammonia, lime, potash, and the salts of different bases, discovered by Thompson and Way, is a palpable proof of it. The chemical composition and the physical properties do not admit of pronouncing upon the degree of fertility of earth. Direct observation is necessary. It is imperative to cultivate a plant in the soil, and ascertain its vigor and development. The analysis will be useful in determining the quantity and quality of assimilating elements.*

The memoir of Schübler comprises one hundred pages. I have made an abstract of the principal parts which may interest farmers, excluding all the tables of the physical properties of different soils. I may add that the experiments of Schübler are unique up to the present time, and still preserve their scientific value on that account.

Weight of the soil.—In determining this, a particular distinction is to be made between the peculiar specific gravity of the several portions of earth, and the absolute weight of a determinate volume, as of a cubic inch or foot of the several soils.

1. Sand, either in its wet or dry state, is the heaviest part of arable soil, certain fine slaty marls approaching the nearest to sand in this respect.

2. Calcareous and siliceous sands differ but little in this point, calcareous sand being, however, the heaviest of the common constituents of arable soil.

3. The clays are lighter the more clay and the less sand they contain.

4. Lime exhibits great difference in weight, according to its fineness and mode of preparation. In slaked lime the weight is remarkably less, even after it has been resaturated with carbonic acid. The explanation of this seems to be the great expansion of quicklime on its combination with water. Dolomite sand, or a combination of lime and carbonate of magnesia, is much heavier than either of its component parts in a separate state. Its specific gravity rises to 2.82 and 2.83, and even magnesian stony marls often possess this greater weight.

5. The carbonates of magnesia, obtained by precipitation from solutions, are the least weighty of the usual ingredients of soil. In arable soils magnesia is usually found in combination with lime or silica, where its form is coarser, and its physical properties resemble more closely those of sand.

6. Humus has the least specific gravity, and, excepting pure artificial magnesia, the least absolute weight.

* Annales des Sciences Naturelles, 1859, vol. xii, p. 354.

7. Compound arable soils are generally lighter as they are proportionally richer in humus. This fact alone does not positively indicate the fertility of a soil, since the humus itself differs in weight, and the other pure earths exhibit diversity of weight according to their fineness; consequently, mixed earths may acquire very different average weights. On this point specific gravity furnishes more certain evidence than absolute weight.

8. The designations of light and heavy soils, as usually employed, refer to the different consistence of the earths, and not to their specific gravity or absolute weight; clay soils, wet and dry, are heavier than sandy soils.

Weight of artificial mixtures of earths.—When different earths are artificially combined, a cubic inch of the compound gives a greater weight than the common average of the component earths, whether mixed in equal portions, according to weight and volume, or in other quantities.

Power of soil to contain water.—By this term we understand the property of earths to receive and retain water within their interstices, without allowing any to escape. It is of the greatest importance to vegetation, for on it depends the quantity of aqueous nourishment the soil can receive and supply to the roots of plants—an essential source of vegetable nutriment.

1. The sands are most deficient in this power; its degree varies, according to fineness in the grain, from 20 to 40 per cent.; siliceous sand has the least power of all.

2. Gypsum powder approaches the sands in this respect, and has even less power of containing water than calcareous sand.

3. Slaty marl, despite its proportion of clay, exhibits very little of this power, and renders soil both warm and dry. This marl is frequently applied to the improvement of vineyards in Germany.

4. In carbonate of lime this water-holding power varies according to fineness of the particles; a distinction is important, therefore, between the fine lime separated by decantation and the earthy lime as found in the form of sand in arable lands.

5. Carbonate of magnesia exists in a coarse-grained state, combined with lime or siliceous earth, in arable soils, and retains water only in a slight degree.

6. Humus, with its large natural proportion of half-decomposed organic remains, as wood, leaves, roots, &c., has the greatest degree of this power. One hundred parts of the fine earth formed by decaying wood in old trees are capable of absorbing nearly two hundred parts of water; and some light turf earths can contain from three hundred to three hundred and sixty parts, even when dried artificially. Where we meet with the power of retaining more than ninety parts of water, we may depend upon an abundant commixture of organic matter.

Firmness and consistency of soil.—These two qualities are of great importance in regard to the fertility and the manipulation of land; the terms, universal in husbandry, of light and heavy soil, rest mainly on these properties, and they therefore deserve investigation in regard to both dry and moist conditions of the earth.

1. If we compare the consistency of earths with their weight, we shall see that the customary terms of heavy and light soil are founded upon the cohesion of soil within itself and its adhesion to agricultural implements, and they therefore indicate its working properties rather than its weight. The comparative ease with which roots penetrate the soil will probably accord with these conditions.

2. The consistency and firmness of soils in the dry and wet state in-

crease in the same ratio. Clay lands, either wet or dry, are the most difficult to work; sandy soils, and those containing much humus, are the most easy.

3. The firmness and consistency of a soil are not in the direct degree of its power of containing water; thus, fine lime and magnesia and humus possess but little consistency, although they can contain much water. We cannot, therefore, infer the existence of the one property from that of the other.

4. Consistency generally exceeds in clayey soils, but not invariably. Fine, slaty marl, notwithstanding its great proportion of clay, has but slight consistence. The finest kind of pipe-clay in its dry state is only forty-two, and therefore less by half than that of the heavy, gray clay of arable soils.

5. Light, sandy soils gain cohesive power by moisture; therefore, a damp climate, with a large average quantity of rain, will be found most advantageous to sandy districts. Even the purest sand, which in its dry state loses all its consistence and falls into a shapeless powder, regains a certain degree of cohesiveness on again being wetted.

6. With all the earths, adhesion to wood exceeds that to iron; and the apparent contradiction of the fact that, in wet weather land is more easily worked with wooden than with iron implements, is explained not by the less degree of adhesion to wood, but by the weight of the iron implements causing them to sink deeper into the soil.

Diminution of the consistency of soil by the penetration of frost.—After the thorough freezing of soil in a wet state, its degree of consistence is greatly decreased. This is especially the case with clays and soils of great firmness, where the diminution amounts to nearly one-half; with loamy clay the reduction reaches from sixty-nine to forty-five, and with ordinary arable soil from thirty-three to twenty. Completely dry earths suffer no change from the action of frost. This is because the crystallization of the water in the interstices of the soil by freezing forces the several particles of earth from their position, and thus renders the points of contact fewer. The beneficial influence of breaking up the soil before winter sets in, to allow the frost to penetrate more readily, depends upon this diminution of consistency. If the soil is worked in too wet a state in early spring the beneficial results are lost by again bringing the earthy particles into close contact. The throwing out of plants in changeable winters is caused by the alternate freezing and thawing of the ground, and the accompanying displacement of earthy particles forcing the roots of smaller plants out of the earth, but not displacing the larger ones.

Capability of soils to become speedily dry.—It is a question of considerable importance in vegetation whether a soil gives up its acquired moisture again to the air quickly, or retains possession of it for a long time in its force.

1. The terms of a hot or cold, a dry or wet, soil rest chiefly on this capacity. Sand, gypsum, and slaty marl dry most quickly, and are consequently called hot soils.

2. Carbonate of lime varies in this respect according to the different forms in which it occurs. Calcareous sand dries quickly, and fine carbonate of lime slowly. The latter has, besides its chemical action on humus, the advantage of loosening the soil after it is dried.

3. This property of the earths, to require a longer or shorter time to become dry, might seem to stand in the same relation as their power of containing water, and, with thin layers, this is nearly always the case; but with layers some inches in depth the proportion deviates consider-

ably; the deeper layers, in this case, drying more slowly, according to their degree of consistency, and to their greater or less contraction on drying. Dry soils, with a large proportion of clay, exhibit this variation in an especially striking manner.

Diminution of bulk on drying.—Most soils contract on drying, and cracks and fissures ensue, which have an injurious effect on vegetation, as the finer roots, which frequently supply the bulk of nourishment, are either bared or torn asunder.

1. Gypsum diminishes its volume in an inconsiderable degree.

2. Fine carbonate of lime loses but little bulk, while clay exceeds it, and humus exhibits a remarkable degree of contraction.

3. The addition of sand, or carbonate of lime to clay, diminishes this property of contraction.

4. Many kinds of marl fall into small pieces on drying, because of the great difference which clay and lime, the elements of marl, experience in their diminution of bulk on drying, after having been moistened, these individual parts changing their volume in different degrees, and thus causing a more easy disintegration.

5. Humus experiences, on drying, the greatest diminution of bulk, contracting at least one-fifth, and expanding again under the action of moisture. This is why the upper surface of the earth, in damp, turf bottoms, containing much humus, frequently rises or sinks several inches, according as the soil is penetrated with more or less water. The elevation of these soils is more remarkable during a sharp frost, after wet weather, the freezing, by its expansion, still further increasing the volume of the particles of water within the turf. Hence, too, the reason why these turf bottoms have, in their wet state, a remarkable elasticity if heavily trodden upon.

Property of the earths to absorb moisture from the atmosphere.—Most of the earths which are commonly found in soils have the property, in their dry state, of absorbing moisture from the atmosphere, and this influences, considerably, their different degrees of fertility.

1. All soils, excepting siliceous sand, thus absorb moisture. Slaty marl, similar to the sands in some conditions, surpasses them in this respect; clay soils, especially those containing humus, absorb most freely.

2. Humus, although possessing the greatest power of absorption, exhibits degrees of difference according to its kinds; purely vegetable *humic acid* absorbs moisture more freely than that obtained from animal manure.

3. The degree of absorption lessens as soils become saturated with moisture, which generally occurs in a few days. A portion of the absorbed moisture becomes vaporized by the action of sunlight, and thus is performed a natural operation which exerts a very beneficial effect upon vegetation. The earths absorb, at night, moisture which they partially give off during the day.

4. While fertile arable soils absorb moisture freely, this is not an infallible test of their properties, and the test requires much modification in its application.

Property of earths to absorb oxygen gas from the atmosphere.—Alexander Von Humboldt, many years ago, pointed out this property of the earths, and experiment confirms it, always providing that the earths are in a moist condition.

1. All the earths lose this property upon drying, and regain it as soon as they are moistened.

2. Humus exhibits it in the greatest degree; the clays approach near-

est to it, and the sands absorb least. Fertile earths absorb more than those poorer in humus and clay. The included air, standing over them, at last becomes so void of oxygen, that lights are extinguished, and animals die in it.

3. The methods of absorption differ; humus combines partly with the oxygen, chemically; the inorganic earths absorb the gas without intimate combination.

4. When earths are frozen or covered with an icy surface, absorption of oxygen ceases; and the action increases with the warmth of temperature, varying from 59° to 65¾° F. Many phenomena prove that oxygen is an important agent in vegetable as well as in animal economy. It is particularly necessary to the germination of seeds and the growth of plants. By turning up the soil in any manner fresh layers are brought into contact with and fertilized by the oxygen, and as a moist condition of soil favors this absorption, it should be preserved.

Power of the earths to retain heat.—The earths have the power of retaining the warmth which they accumulate from the atmosphere and the heat of the sun, and of giving it out to surrounding bodies. It is different from specific heat, and its degree depends upon the capacity of the body for conducting heat.

1. The sands possess this power to the greatest extent; hence the heat and dryness of sandy districts in summer. Their slight water-containing power, in consequence of which little warmth is lost by evaporation, increases this condition.

2. Slaty marl stands next to sand in this capacity; and this, joined to its greater power of retaining water, contributes largely to its fertility.

3. Humus has the least power of retaining heat, and turf soils abounding in humus warm but slowly, because they contain water, only a small portion of which they lose rapidly by evaporation.

4. Magnesia, combined with sands and slaty marls, largely possesses this heat-retaining power.

5. The greater the mass of an earth the more extensive will be its power of retaining heat. We may, therefore, from the absolute weight of an earth conclude tolerably well in regard to the extent of its power.

Warming of soils by the sun.—The various earths acquire heat from the sun in different proportions, and this property may exert a sensible influence on vegetation. Land consisting of light-colored clay warms less quickly and powerfully in the sunlight than a dark, dry soil; black garden-mold, rich in humus, becomes much warmer than meager limestone or clay soils. Very different external circumstances may affect the warming of the soils, and may be classed as follows: 1st, the different colors of the surface earths; 2d, the different degrees of dampness present during the exposure of the earths to the sun's influence; 3d, the component materials of the earths; 4th, the different angles at which the sun's rays fall upon the soil.

1. The influence of the color of soils on the quantity of heat received by them may be tested as follows: Place thermometers in the several soils, covering their bulbs an eighth of an inch high with earth; sprinkle the surfaces, by means of a fine-lawn sieve, with lampblack for a black color, and magnesia for a white, leaving one soil of its natural color. In August, with a temperature in the shade of 77° F., the increase with the black color was found by Professor Schübler, of the University of Tübingen, to be from 77° to 123½° F.; the white from 77° to 110° F.; and the natural color from 77° to 112½° F. Thus, the increase of temperature with the black-colored earth was 46½°; with the white, 33°; and with the natural, 35½°. Other colored earths exhibit corresponding

differences of degree in temperature. When exposed for hours to the sun they never attain the same degree of heat—the black earths acquiring the greatest heat and the lighter ones remaining cooler.

2. If we expose earths of the same kind in a dry and a wet state to the sun, the wet earth never attains an equal degree of heat with the dry. The depression of temperature arising from evaporation amounts to 11¼° to 13½° F. As long as the earths remain saturated with water they show little difference in their heat-acquiring powers, as they give off to the air, in this condition, nearly equal quantities of vapor in the same length of time; as they gradually dry, the difference in temperature increases. Light-colored earths, with great water-containing powers, acquire heat slowly, while dark-colored sand and slates, containing less moisture, become heated more quickly and powerfully.

3. The different ingredients which enter into the composition of soils have, in themselves, far less influence on the capacity of soils to become warmed by the sun than their color and dryness. If we impart, artificially, to earths the same color and expose them in a similarly dry condition to the sun, the differences in temperature will be inconsiderable; so that the various capacities of earths, in their natural state, for receiving heat from the sun, depend particularly upon their color and dryness.

4. The inclination of the ground toward the sun has a very considerable influence on the degree of heat which the soil receives from its rays, and the greater warmth is produced as the incidence of the ray approaches more nearly to a right angle, or 90°, with the surface. If the actual increase of the temperature in the sun over that in the shade be between 45° and 63°, as is often the case on clear summer days, this increase would be only half as great if the same light spread itself, in a more slanting direction, over a surface twice as extended. This is the reason why heat so frequently increases on the slopes of mountains and rocks which have an inclination toward the south. When the sun is at an elevation of 60° above the horizon, as is more or less the case toward noon in the middle of summer, the sun's rays fall on the slopes of mountains which are raised to an inclination of 30° to the horizon, at a right angle; but even in the later months of summer the sun's rays frequently fall on them under a right angle in cases where the slopes are yet steeper. Such declivities, particularly in the geographical latitude of Germany, are therefore peculiarly suited to the cultivation of plants which require a high temperature, such as the vine. By an accurate comparison of the power of the sun's rays to warm the soil, with reference to the different seasons, we shall perceive more distinctly the influence of the different inclinations of the ground toward the sun.

Capacity of soils to develop heat within themselves on being moistened.—Powdery substances in general, and consequently the earths, possess the property of developing warmth when moistened while in a dry state; but in nature they are scarcely ever found in this perfectly dry condition. The rain falling in warm seasons is many degrees colder than the lower stratum of the atmosphere and the upper surface of the earth, which it immediately moistens; so that the earth in hot weather becomes rather cooler than otherwise by the rain. When the earth has previously been very dry, the cooling of it by the rain can only be reduced about one degree of Fahrenheit, and this would have little effect on vegetation, and in the colder seasons, when the earth is already damp, so slight a development must be inappreciable.

Galvanic and electrical relations of the earths.—The pure earths, as sand, lime, magnesia, and gypsum, in their dry state, are non-conductors;

the clays are imperfect conductors; and the clayey earths are weak, imperfect conductors. The presence of the moisture and of oxide of iron, found in all the clays, appears to be the base of this phenomenon.

Influence of the simple earths on the germination of seeds.—The development of the germ depends upon the looseness, moisture, and temperature of the soil, as well as upon its warmth and consistence.

1. In moist siliceous and calcareous sand the grains germinate in summer in a few days, and develop well, but suffer as hot weather approaches.
2. In gypsum powder they develop indifferently.
3. In sandy clay no proper development takes place.
4. This is also the case in loamy and stiff clay.
5. In pure clay no change whatever occurs, but the grains develop well when transferred to proper soil.
6. In pure carbonate of lime, carbonate of magnesia, and slaty marl, as well as in pure humus, garden-mold, and arable soil, the seed germinate well—the young plants in warm weather developing themselves most beautifully in the humus, and in the carbonate of magnesia, in consequence, probably, of the greater power of containing water which these earths possess.

Soil as adapted to climate.—In such warm countries as have also a small mean quantity of rain, those kinds of soil which have a great power of containing water will, if other circumstances are the same, be the best; while those soils which have, on the contrary, a small power of containing water will be found better suited for countries with a greater amount of rain. Those very soils, therefore, may be fertile for one country which become no longer so for another, under a change of external circumstances; the usual alternation of dry and wet years being on the same principle, more favorable to the one or to the other country, according as their predominating soils respectively possess a greater or less degree of this power of containing water.

General remarks on the foregoing.—In the examination of soils, the determination of their power of containing water, and of their weight, consistency, and color, in connection with their chemical analysis, will, in the majority of cases, be sufficient to enable us to conclude, with great probability, as to their remaining physical properties. The more an earth weighs, the greater also in general is its power of retaining heat; the darker its color, and at the same time the smaller its power of retaining water, the more quickly and strongly will it be heated by the sun's rays; the greater its power of containing water, the more has it in general the power also of absorbing moisture from the atmosphere when it is in a dry state, and oxygen when it is in a damp state, and the slower it usually is to become dry, especially when it is endued at the same time with a high degree of consistency. Lastly, the greater the power of containing water, and at the same time, the consistency of a soil, the colder and wetter of course that soil will be, as well as the stiffer to work, either in a wet or dry state, and the more judicious therefore will it be to break it up before the setting in of the frost, in order that its consistency may be improved by the due penetration of the frost during the winter; and for the cultivation of many plants, the more requisite will it be found for the permanent improvement of such a soil, to counteract its too great consistency and power of containing water by mixing it with looser earths, as lime, marl, and sand.

In this and the preceding report, the French thermometrical centigrade scale has been used frequently. To convert this into the Fahrenheit scale, we must remember that 5 centigrade degrees are equal to 9° Fahrenheit; so each centigrade degree amounts to 1.8° of Fahrenheit.

It must be remembered also that the zero or freezing point of the centigrade corresponds to 32° Fahrenheit.

ANDRÉ POËY

Hon. HORACE CAPRON,
Commissioner.

THE AMERICAN POMOLOGICAL SOCIETY

A REPORT OF ITS HISTORY AND PROGRESS.

SIR: In conformity with your request, I submit a brief sketch of the American Pomological Society, its history, its progress, and its work. The convention which laid the foundation of this society first assembled in the city of New York, pursuant to a call signed in behalf of the horticultural societies of Massachusetts, Pennsylvania, New Jersey, and New Haven, and the American Institute, on the 10th of October, 1848. The objects of this convention were stated in the circular by which it was called, as follows:

To compare fruits from various sources and localities with a view of arriving at correct conclusions as to their merits, and to settle doubtful points respecting them; to assist in determining the synonyms by which the same fruit is known in different parts of the country; to compare opinions respecting the value of the numerous varieties already in cultivation, and to endeavor to abridge, by general consent, the long catalogue of indifferent or worthless sorts at the present time propagated by nurserymen and fruit-growers; to elicit and disseminate pomological information, and to maintain a cordial spirit of intercourse among horticulturists.

Nearly all the leading fruit-growers and pomologists of the country were present, among whom may be named the late A. J. Downing, William R. Prince, William Reid, and Dr. R. T. Underhill, of New York; Dr. W. D. Brincklé, of Pennsylvania; Samuel Walker, B. V. French, and H. H. Crapo, of Massachusetts; Dr. A. S. Munson, of Connecticut; A. H. Ernst, of Ohio; Thomas Hancock, of New Jersey; L. C. Eaton, of Rhode Island; Joshua Pierce, of Washington, D. C.; and Dr. J. W. Thompson, of Delaware; and of those who still live, John J. Thomas, P. Barry, Charles Downing, S. B. Parsons, and George Ellwanger, of New York; Lawrence Young, of Kentucky; Charles M. Hovey and Robert Manning, of Massachusetts; Edward Tatnall, of Delaware; Robert Buist and Thomas P. James, of Pennsylvania; and F. R. Elliott, of Ohio.

The convention was called to order by General Tallmadge, president of the American Institute, and its presiding officer was the present incumbent of the chair, with a vice-president from every State represented. The secretaries were S. B. Parsons, of New York; George Deacon, of New Jersey; and P. Barry, of New York.

This convention adopted the title of "The American Congress of Fruit-Growers." Its first work was the appointment of a special fruit committee, of which the late A. J. Downing was chairman, to report a list of fruits worthy of general cultivation. After a session of three days spent in the discussion of this list—which resulted in its adoption, with very few changes—and in interesting discussions of other varieties, the congress adjourned to meet in the city of New York, on the first Tuesday of October, 1849.

A similar meeting was held about the same time at Buffalo, New York, under the auspices of the New York State Agricultural Society, which

took the title of the North American Pomological Convention, and which, at the meeting in New York, October, 1849, was united with the American Congress of Fruit-Growers, under the name of the American Pomological Congress.

The next meeting of the congress was at Cincinnati, in 1850. The president, however, owing to a death in his family, was unable to be present, and Dr. W. D. Brincklé was chosen president. Since this meeting the sessions have been held biennially, the next being at Philadelphia, in 1852, when, Dr. Brincklé having declined a re-election, the former presiding officer was again called to the chair, which he has occupied ever since. At this session the death of Mr. Downing, which occurred a short time previously, was announced in a eulogy delivered by the president, at the invitation of the horticultural societies of Pennsylvania and Massachusetts. A constitution and by-laws were also adopted, and the name was changed to the "American Pomological Society." The session of 1854 was at Boston; 1856 at Rochester; 1858 at New York, when a large number of varieties of fruits was added to the rejected list, making, with seventy-two pears discarded in 1854, and a few at other sessions, six hundred and twenty-five varieties of fruits rejected. The session of 1860 was at Philadelphia; 1862 at Boston, when the present plan of the society's catalogue was adopted, and 1864 at Rochester. The session of 1867 was held at St. Louis, being the first meeting west of the Mississippi River; that of 1869 at Philadelphia, when for the first time specimens of fruit from California were shown, as well as fine exhibitions from Kansas and other new States, and that for 1871 is appointed at Richmond, Virginia, on the 6th, 7th, and 8th of September, when, it is anticipated, the whole country, South and North, will be more fully represented, both by men and fruits, than ever before.

The progress made by this society is forcibly shown by the fact that, while our select list of twelve pears in 1848 had, only eight years later, increased to ninety-four, the standard of excellence has not been lowered, but raised. Twenty-five years ago, every new fruit of good quality was at once recommended for more or less extensive cultivation. If a good bearer, it was so much the better; if a hardy and vigorous tree, better still; but quality was all that was deemed indispensable; while to-day a fruit must combine, in a good degree, all these and many other points, or it will not stand the test of this society; and even some of those then thought most desirable are now on the rejected list. We hear no more of varieties which, though not of sufficient excellence for extensive cultivation, are yet so good that a single tree should be in every large collection; a sort worthy of no more extensive cultivation is now deemed not worth growing at all.

The American Pomological Society has brought together, from more than thirty States and provinces, the most intelligent, experienced, sagacious, and skilful cultivators, who have taught each other and made the knowledge of one the property of all. Its example has led to the formation of similar associations in England, France, and Belgium, and of local associations in our own country.

Its published proceedings, embracing reports of discussions, reports of committees, catalogues, and papers on various pomological subjects, embody, in a condensed form, a mass of information on this science—the best thoughts of the best cultivators throughout our land—possessed by no other nation on earth. Instead of the fifty-four varieties recommended in 1848, its catalogue now contains the names of five hundred and eighty fruits, viz: one hundred and seventy-six apples, one hundred and seventeen pears, thirty-nine cherries, fifty-one peaches, six nec-

tarines, twelve apricots, thirty-six plums, four quinces, thirty-seven native grapes, twenty-two foreign grapes, twenty currants, thirteen gooseberries, eighteen raspberries, four blackberries, and twenty-five strawberries. The list of one hundred and twenty-six varieties rejected in 1849 has grown to six hundred and twenty-five, viz: one hundred and twenty-six apples, three hundred and fifty-one pears, five apricots, thirty-two cherries, two grapes, thirty-one plums, three raspberries, and seventy-five strawberries; making a total of one thousand two hundred and five varieties of fruit on which the society has set the stamp of its approval or rejection.

While the results achieved by other societies are of undoubted local value, the work of this national society is a common possession to every inhabitant of our wide land. Perhaps the most important and valuable work it has accomplished, is its catalogue of fruits adapted to the various sections of our country. Into this is condensed the substance of all its proceedings and the various State reports. This list is in a progressive state, and with every revision it may be expected to approximate more nearly to perfection.

The number of delegates attending the first meetings at New York was 107, while our present list of members counts 311, from almost every State and Territory. The cultivation of fruits has so greatly increased since the formation of this society that it is difficult to convey any idea of its expansion to those who have not watched it from the beginning. At that time the work of testing the best varieties of the pear had not generally commenced, and the few pear orchards planted were on a very limited scale, while now we have orchards of tens of thousands of trees, and single varieties planted by the five thousand. The native grape, as to its improvement, and consequently its cultivation on an extensive scale, may almost be said to have been created since the origin of this society. Among these new varieties are those so well adapted to every part of the country, that we find vineyards covering in the aggregate thousands of acres, where formerly not one was to be seen. The planting of grapes for wine was then hardly thought of, and California, where nearly four million gallons of wine were made in 1870, was then practically an unknown land. Indeed, in the whole history of horticulture nothing has ever been witnessed like its progress on our western coast. In regard to the grape, who can doubt that California, with its high temperature and dry atmosphere, fully equal to the most favored portions of Europe, with suitable lands of almost boundless extent, where grapes are produced at as little cost as anywhere on the globe, and where in some sections of the State wine can be stored in open sheds instead of costly cellars, without injury, is destined to become one of the greatest grape-growing and wine-producing countries of the earth? Already some of their wines, made from foreign grapes, compare so favorably with the sherries and Burgundies of Europe as to leave no doubt of their being legitimately classed with these, and with which, considering their age, they do not suffer by comparison. The fig grows almost spontaneously, and bears abundantly; and as soon as the process of drying is understood, it will become one of the most important products of the soil. The culture of the almond and olive, as well as of silk, gives promise of profitable results.

In regard to progress in the cultivation of small fruits we select the strawberry as the most important. In the first select list of this society only three sorts were mentioned, while the present list contains twenty-five kinds approved for cultivation in some part of the country, not to mention the hundreds of others possessing more or less merit which

have been introduced, and the many now under examination by the society. The extent of plantations of this fruit has increased in a corresponding ratio. From Norfolk, Virginia, where twenty years ago its cultivation had not commenced, two millions of quarts have been sent to the market in one season; and from a single railroad station in Illinois, a thousand bushels have been sent daily to market. I might speak in a similar strain of the other small fruits, which in many families form almost the total diet in the summer season. As to the apple and peach, their cultivation has so increased as to be hardly stated on paper. Then, the interest, discussions, and correspondence in regard to fruits were confined to narrow limits; now, through the members and the publications of this society, it has spread all over the country. Then, the principles and practice of fruit culture were unsettled and unsystematized; now, by the united experience of the oldest and best cultivators in the land, many of these have been well determined, thus furnishing the most reliable information. Then, very few experiments had been made in artificial hybridization or cross-fertilization for the production of new varieties of fruit; now, enterprising cultivators all over the country are using those processes of scientific manipulation to originate improved varieties. These experiments have thus far been made chiefly with the grape and strawberry, but they will doubtless soon be applied to other fruits; so that the production of new varieties, suited to every locality in the country, is but a question of time. Then, the nomenclature of our fruits was in a chaotic state; now, this confusion has been so far cleared up and systematized that one of the most striking points in regard to the collections of fruits exhibited from Kansas and other new States is the correctness and uniformity of their nomenclature, and the same observation may be made in regard to the varieties cultivated in California, as we have witnessed the past season.

No better illustration could be given of the value of the work of this society, than the fact that, whether on the Atlantic or Pacific coast, or in the central valleys, its publications are eagerly sought after as authority, thus giving a standard of pomology to every section of our country. By reference to its catalogue the cultivator in any State, and in some instances any section of a State, can ascertain at a glance what varieties of fruit have been proved by experience to be best adapted to his locality. By constant revision, and the addition of new fruits as fast as tested, and proved to be of value for general cultivation, these lists will become yearly more full and complete. Nor have the labors of the society been confined to designating the fruits most desirable for planting; the rejected lists making known those which should not be planted, are at least of equal value. The researches of the society have not been confined to our own native fruits, but no sooner is a new foreign variety made known than it is transferred to our collection for trial, in the hope that it may be adapted to some section of our widespread country. Nor are these enterprises limited to this society; other associations, stimulated by our exertions, are recognizing the importance of fruit culture as one of the most pleasant and profitable departments of industry. Our labors have received the sanction of the Government, inasmuch as the Department of Agriculture has for many years directed its attention to this branch of its work. The collection of native grapes gathered under the direction of Mr. Saunders, the superintendent of the experimental garden of the Department, will be of the highest value to the grape-growers throughout the country, by testing the different varieties, and establishing a correct nomenclature of American grapes; while the collection of Russian apples, lately procured by the

Department, if it results in introducing a single variety, adapted like the Red Astrachan to every part of the country, or a variety which will endure the cold of the Northwest, where the ordinary kinds fail from the severity of the winters, will be worth many times its cost to the country.

Among other objects specified in the circular by which the first meeting of the Congress of Fruit-Growers was called together, is this: "To maintain a cordial spirit of intercourse among horticulturists;" and, although last mentioned, and to be effected rather by incidental and indirect than by direct means, it has not been forgotten, as the joyous greetings and kindly partings, the generous hospitalities given and received at its meetings, bear witness. Nor has the influence of these amenities ceased with the close of our sessions, but remained with us, in pleasant anticipations of the time when we should again come together in mutual congratulations, as we hope and trust ever to do.

MARSHALL P. WILDER.

Hon. HORACE CAPRON,
Commissioner.

REPORT OF THE EDITOR.

SIR: The investigations and other labors of the Department, not reported either in the regular or special reports of the preceding pages, have been more numerous and more extended than in former years.

Activity, approaching restlessness, is the predominent characteristic of agricultural thought in this country at the present time. The ambitious young farmer, with little capital in money and much in muscle, is seeking cheap land and promising branches of culture, while the cultivator of advancing years and successful experience is turning from mere speculation in land to rational processes of scientific agriculture; and this Department is daily called upon to lead the way in the solution of knotty questions presented by workers in a broad field, laboring in every branch of rural avocation, trained to every degree of varied efficiency, and imbued with the teaching of every practical school of husbandry of the civilized world. It is made the province of the Department, by the organic act which instituted it, to aid in resolving these difficulties, and harmonizing the contrarieties in practice resulting from diverse education, occupation, climate, and other circumstances, by investigations, researches, and collocations of illustrative facts, more extended and persistent than individuals in these superficial times can afford to undertake.

Necessarily this research is largely statistical, and the summary of its results must embrace material brought to light through its agency, as well as that communicated officially by coöperating societies, and to some extent the corroborative and allied facts presented in current publications. In this view, the collection of "Current Facts in Agriculture," and "Recent Farm Experiments," made with regard to their intrinsic value for completeness and utility as a record for future reference, is deemed a work of much importance, even though an occasional experimenter may have communicated the results of his labors to the public through some other channels. An eminent professor of practical agriculture, in communicating his appreciation of this feature,

affirms that no one realizes fully the value and "comfort of having an assemblage of such facts, scattered through innumerable reports and papers, brought together into one focus year after year, so that the experimenter and theorizer may have a large number of ascertained facts with which to compare his own experiments and his own theories."

The special investigations of the past year, many of which are not yet complete, include an examination into the industrial condition and progress of settlement and improvement of our immense Rocky Mountain area; the evidences of industrial diversification, and the adoption of advanced agricultural practice in the Southern States; the possibilities of great natural advantage in the introduction of plants manifestly suited to some section or climate of the country; the diseases and mortality of farm animals; the question of transportation of farm products, its cost and its abuses; the development of the industrial college enterprise; the progress of beet-sugar making, forest culture, silk production, and other enterprises by which the varied tastes and capacities of our population, native and immigrant, may be utilized, the major industries of agriculture relieved from injurious competition in production, and the minor products required by the increasing wants of our civilization may be obtained from our own soils by our own labor.

Much labor has been expended in the collection of facts illustrating the resources and settlement of Western America, the great region west of the valley of the Missouri, and fragments of this information may be found in the present report; but the theme is so large, the territory which it covers being continental in extent, and so isolated as to render its thorough canvass a difficult enterprise, that new and more extended researches will be undertaken, with the hope of presenting the freshest and most complete and condensed view of the capabilities and agricultural condition of this new territory ever yet offered to the public. A great obstacle to full success in this undertaking has been the extremely limited appropriations available for such work.

Another important investigation, which is not yet complete, has relation to the changes in the agriculture of the South, its products, processes, and labor. A section only of this material has been embodied in the present volume. Much valuable information has been obtained relative to the truck-farming and fruit-growing of this region, partly for local supply but mainly for northern markets; and the subject will be more fully examined for presentation in the next report. The rapid development of new enterprises in the production of subtropical fruits in Florida will greatly enhance the interest and value of a report thus necessarily deferred to include the operations of 1871.

While this work has been continued by the Department, mainly by its regular working force and through its peculiar machinery and channels of communication, the arrangement of its collected material has been in some cases confided to experts employed temporarily for the purpose. Of the matter which follows in the present volume, that relative to *Epizoötic aptha*, the foot and mouth disease of cattle, which caused so much alarm in New York and New England, is given under the authority of Professor James Law, of Cornell University; the examination into the anatomy and diseases of the horse's foot was made by Professor T. R. Crosby, of the New Hampshire Agricultural College; the peculiarities of the agricultural patents of the year have been considered by Dr. J. Brainard, agricultural examiner in the Patent Office; the article on the food fishes of Alaska is supplementary to a former report upon the resources of that Territory, by Mr. Wm. H. Dall; in the arrangement of the abundant material descriptive of the character and abuses of the

market systems of our large cities, the assistance of Mr. Joseph B. Lyman, agricultural editor of the New York Tribune, has been enjoyed; returns concerning the present status of Virginia agriculture were embodied by Mr. Thomas S. Pleasants, of Petersburg, Virginia; the description of the agricultural capacity of Wyoming and a portion of Utah is a report by Rev. Cyrus Thomas, of an exploration made in 1870; Mr. N. C. Meeker reports the progress of colonization and the results of irrigation in the Territories; Dr. H. Latham, of Laramie City, Wyoming, communicates the statement concerning the pastoral capabilities of that region; Mr. Elihu Hall, of Athens, Illinois, gives results of experiments with the grasses of the prairies and northern plains; and Dr. Edward Palmer presents the results of personal observations concerning food products of the North American Indians.

In the present volume are found continuations of the history of the organization and development in the work of industrial education, the annual digest of the State reports, the spirit of recent issues of agricultural literature, and other annual indices of rural activity and progress.

J. R. DODGE,
Editor of Reports.

Hon. HORACE CAPRON,
Commissioner.

TESTS OF DEPARTMENT SEEDS.

The importance of careful experiment and detailed report by those to whom is intrusted the test of seeds distributed by this Department, has been repeatedly urged. The thoughtlessness or the greed which would cause the consumption or waste of new and approved grains or seeds, is guarded against by the exercise of care in the selection of the proper persons to make these tests; yet the Commissioner cannot be held responsible for that portion of the distribution made by members of Congress. While returns detailing the experience of experimenters are yet too often neglected, there has been a vast improvement in the past year, which has secured more valuable reports in larger numbers. The benefits of the distribution as shown by these partial indices outweigh its expense in a manifold degree, and show how, in the economy of nature, large production comes from smallest germs. While the cost of seed distribution in 1869 was but half a dollar for each thousand of the people, there is reliable evidence that a single specimen of grain distributed in one of the thirty-seven States has realized in enhanced production ten times the amount expended for all seeds sent to all the States in that year.

The Department has distributed during the year ending December 31, 1870, 358,391 packages of seeds, including the varieties mentioned in the accompanying tabular statement. Of these packages 4,624 included under the head of miscellaneous were distributed to representatives of this Government abroad, and in exchange with foreign societies and associations. The distribution during the year, as in the preceding one, has been chiefly made through members of Congress, statistical correspondents, meteorological observers, and State and county agricultural and horticultural societies and farmers' clubs, reporting regularly to the Department.

Tabular statement showing the quantity and kinds of seeds issued from the seed division of the Department of Agriculture during the year ending December 31, 1870.

Seeds.	To whom sent.					Amounts.
	Members of Congress.	Agricultural societies.	Correspondents.	Meteorological observers.	Miscellaneous.	
Vegetables, 149 varieties .... packages..	63, 017	57, 973	61, 463	7, 960	48, 111	238, 577
Flowers, 53 varieties .... do......	22, 410	60	....	....	19, 255	41, 725
Field cereals:						
Winter wheat, 5 varieties .... do......	13, 069	2, 801	21	....	2, 210	18, 101
Winter rye, 1 variety...................... do......	2, 147	640	....	....	231	3, 018
Oats, 4 varieties .... do......	5, 956	2, 888	40	....	1, 677	10, 561
Barley, 3 varieties........................... do......	69	4, 998	951	....	634	6, 652
Corn, 11 varieties .... do......	....	....	....	....	316	316
Textiles:						
Hemp, 3 varieties .... do......	56	....	....	....	131	187
Cotton .... do	6	....	....	....	110	116
Ramie .... do......	40	10	....	....	391	441
Other seeds for field culture:						
Turnips, 9 varieties .... do......	4, 325	2, 040	1, 080	....	363	7, 808
Tobacco, 7 varieties .... do......	21, 213	250	7, 275	....	1, 520	30, 258
Sorghum, 4 varieties .... do......	54	....	10	....	276	340
Clover, 4 varieties............................ do......	95	4	5	....	621	725
Osage orange................................... do......	2	....	....	....	46	48
Opium poppy .... do......	....	....	....	....	192	192
Rice, 3 varieties............................... do......	....	....	....	....	12	12
Sugar beets, 5 varieties .... do......	42	63	2	....	208	320
Jute, 2 varieties............................... do......	....	....	....	....	453	453
Rye grass, 2 varieties .... do......	512	130	533	....	203	1, 378
Tree seeds, 95 varieties.......................... do......	....	....	....	....	2, 110	2, 110
Total.... ....do......	133, 043	71, 865	71, 400	7, 960	74, 123	358, 391

TAPPAHANNOCK WHEAT.

The Tappahannock wheat, a winter variety, originating in Virginia. and first distributed and brought into general cultivation by this Department, is still a very general favorite. It is remarkable for productiveness, early maturity, and consequent exemption from many of the evils attending wheat culture, and for the excellent quality of its flour, and is suited to a wide extent of country. Mr. Elisha O. Angell, of Manton, Providence County, Rhode Island, writes to the Commissioner that he has for two years sown the Tappahannock wheat, received from the Department through the Rhode Island Agricultural Society, and finds it an excellent grain, well adapted to the Northern States, hardy and free from blast or rust. He exhibited some of it at the New England and New Hampshire fair in September last, and received the first premium. He remarks that wheat which can be grown in Rhode Island near the sea-shore with success, can be grown in almost any part of the country.

In Onondaga County, New York, this wheat is fifteen days earlier than any other variety. A farmer in Cayuga County reports that on common soil, without extra manure or cultivation, it grew well, endured the winter well, the heads were large, and the kernel was plump, and from its earliness escaped both rust and weevil; while the Soules wheat, under like conditions of culture, was ten days later, and rusted badly. A correspondent in Madison County writes that he received from the Department, four years since, a few bags of Tappahannock wheat, and from that seed the variety is now extensively grown, and has proved a valuable acquisition in his section. In Ontario County it is reported to be a valuable variety, being nearly two weeks earlier than other wheat.

thus escaping the midge and weevil, and it withstands the winter well. In Wayne County, last year, it produced twenty-eight bushels to one sown, and is considered a success. From Genesee County a farmer writes that he had three acres of Tappahannock wheat on Tonawanda flats, (bottom land,) which yielded twenty-six bushels to the acre. It was earlier and produced better than any other variety in the neighborhood, doing best in rich, strong land.

In Salem County, New Jersey, the Tappahannock has been cultivated with profit since 1866. A correspondent reports that it ripens ten days earlier than the Amber or Blue Stem, and last fall weighed sixty-two pounds per bushel, while the Amber weighed fifty-six pounds. The yield compared with the Amber was as 3 to 2. He now has fifteen acres of the Tappahannock sown on four varieties of soil.

In Tioga County, Pennsylvania, this wheat is ten days earlier than any other, the kernel plump, and the yield good. It is also successful in Greene County. In Washington County the yield is thirty-fold, and in Lancaster County it produces twenty to twenty-two bushels per acre, while the Mediterranean yields only eight to ten. From Chester County it is reported the most valuable of forty kinds grown there this year, on account of its early maturity.

In Maryland the Tappahannock thrives well, and by some is considered the best winter wheat raised in the State, especially on account of the quality of its flour. In Baltimore County the Tappahannock is considered a very valuable variety, and a correspondent thinks it would do still better, especially as to quality, if less seed per acre were used. In Montgomery County the yield is not very large, but the quality is excellent, and the grain matures early, and escapes weevil and smut.

From ten counties in Virginia reports have been received upon the value of this wheat, all highly favorable, except from Princess Anne, where the want of success is attributed to cold weather in June, producing rust. In Montgomery County the yield is reported large, and the grain perfect, exceeding in quality the seed sown. In Nelson County thirty-four bushels sown broadcast on twenty-eight acres of fallow land, without fertilizers, yielded six hundred and eighty bushels—over twenty-four bushels per acre, and twenty for each bushel of seed. From this county it is reported that want of success with the Tappahannock wheat is due to overseeding. Another correspondent says that the Tappahannock seems well adapted to the climate, and gives general satisfaction, and, he adds, "should it continue to maintain its present standard, this article alone will be worth more to our country than the cost of the Agricultural Department."

In Henry County the yield the first year from the seed furnished weighed seventy-one pounds per measured bushel. In Madison County the Tappahannock and Poland wheat are the best varieties. Twenty-three acres seeded with twenty-seven bushels of the former, in 1869, without fertilizers, yielded fifteen bushels per acre. In Rockingham County, says a correspondent, the Tappahannock has well nigh supplanted all other kinds of wheat. In Northumberland County, which is not a wheat-growing county, the yield without fertilizers is about ten-fold, and quality excellent. In Smyth County it has proved a valuable wheat. In Tazewell, its yield, early ripening, and quality are reported to be all that can be desired. In almost every report of experiments with this variety in Virginia it is highly commended.

In Brooks, Braxton, and Jefferson Counties, West Virginia, the Tappahannock produces well, and maintains its good quality. It is reported that in some portions of the State it freezes out; probably in the more

exposed situations, or on wet soil, as the climate is not too severe for it under ordinary circumstances. In some localities it is pronounced the best wheat known.

A correspondent in Highland County, Ohio, states that one farmer has five acres sown to Tappahannock wheat this fall, the seed being the product of a package sent him two years ago. In Ashland County it is hardy, stands up remarkably well, the grain is superior, and weighs, when very clean, sixty-five pounds per bushel. In Erie it ripens early, does not lodge, and is believed to be "just the thing" for that section. In Butler County a yield of sixty-six-fold and of superior quality is reported, and entire satisfaction is expressed. In Perry, as reported by the secretary of the agricultural society, it makes a greater yield of flour, and of better quality, than any wheat ever grown in the county. In Auglaize it is stated to be the finest and earliest variety known there, and sold, in the autumn of 1868, for $4 per bushel for seed. In Meigs and Logan Counties it is equally a favorite. A farmer in Union County states that he received from the Department, in 1868, one pound of the Tappahannock wheat, which he sowed in drills on limestone-gravel land, clover sod. It did well, and the next season he sowed the product with field-drill on the same kind of land, harvesting about eight bushels. The next season he sowed with field-drill one and one-half bushel to the acre, on very strong limestone-gravel land, clover sod, well manured with barnyard manure, and obtained thirty-six bushels of beautiful, plump, white wheat to the acre. He reports the Tappahannock about ten days earlier than any other variety in that section.

In Kentucky this variety has proved valuable. In Harrison County the quality is reported excellent, and the yield has been as high as sixty-seven-fold on well-prepared ground. In Russell it ripens earlier and produces better grain than any other variety raised in the county. In Lebanon, Marion County, in 1869, where the seed was drilled in on well-prepared ground, the yield was seventy-two-fold of clean wheat, while other wheat on adjoining land, similarly treated, returned only eighteen-fold. The Tappahannock was also the earliest variety to mature. In Garrard County the yield in 1869 is reported, in one instance, at a little more than sixteen bushels per acre, of excellent quality. In Edmonson the yield was twenty-one bushels to one of seed, on old ground, which was considered an extraordinary yield. In Scott County the yield was thirty-fold, and the ripening ten days earlier than other varieties. In Bourbon it succeeds admirably, and ripens earlier than other wheat. Similar reports come from Clinton, Owsley, Scott, Hopkins, Boone, and Livingston Counties.

The Tappahannock has proved a profitable contribution to agriculture in Tennessee. A Coffee County correspondent thinks it superior to all other varieties in the State; its vigorous growth, hardiness, early maturity, freedom from smut and rust, and superior quality and yield of flour, all commending it as the most desirable. In Perry County, where this wheat was drilled in at the rate of one peck per acre, on rich and well-drained clay soil, the yield was at the rate of fifty-two bushels per acre, weighing sixty-four pounds per bushel. Sown broadcast, one bushel per acre, and lightly plowed in, the yield was thirty-eight bushels per acre, and weight sixty and one-half pounds per bushel. On similar soil, with like cultivation, but with two bushels of seed per acre, the yield was only fifteen bushels per acre, and weight fifty-eight and one-fourth pounds per bushel. These experiments were made upon one farm. The advantage of light seeding, with this wheat, is obvious, and is supported by the opinions of cultivators in Maryland and other

States. In Hawkins County the yield was ninety-fold, and, from the peck of seed sent by the Department in 1866, crops of two to ten acres, on eight or ten farms, have been raised the present year. In Greene County this wheat was the principal variety raised in 1869. Complaint is made of its liability to smut in that section, and a successful preventive is reported to be a solution of bluestone used upon the seed. In Sullivan it excels all other varieties, and in Giles County it is reported to be "a decided favorite."

From North and South Carolina a smaller number of reports of experiments has been received than from some of the Southern States, but these are in most cases highly commendatory of the Tappahannock wheat. In Franklin County, North Carolina, the yield is thirty-fold, and in Surry, on upland clay, about twenty-five-fold. In Bertie County, without extra care in preparing the ground, it yielded, in 1869, forty-one bushels for one of seed, and in Harnett thirty-two. In Rowan the yield was thirty-one, and in Montgomery thirty-two-fold. In Lenoir, Stokes, Iredell, Chowan, and Columbus, it proved early and yielded better than the common kinds. In each of these counties it is commended as a valuable acquisition, the grain being excellent in quality, and suited to the soil and climate. In Craven County the yield was greater than that of wheat usually sown, and the quality fine. One correspondent notes the growth of forty stems, with good heads, from one kernel, the wheat spreading more than any before seen by him. In Orange County the yield was twenty-fold the present year on tobacco land, fifteen days earlier than other varieties, and the grain excellent. Hon. John Pool, writing from Pasquotank County, concerning his crop of the present year, states that he sowed six bushels on land that would produce twenty-five bushels of corn to the acre. The product was seventy-five bushels; weight, fifty-nine and one-half pounds to the bushel. This he says is greater than that of any other wheat in his section, and greatly superior in quality. He pronounces the Tappahannock the best wheat for his region that he has ever seen. In Randolph County the yield is not stated to be greatly superior in quantity to other varieties, but the weight, in some instances, is sixty-seven pounds per bushel.

The reports from South Carolina are similar to those from North Carolina concerning the value of this wheat, confirming the favorable reports made last year. Correspondents in Newberry and Union Counties express decided preference for the Tappahannock over other varieties.

In Carroll County, Georgia, the yield of Tappahannock wheat, in one instance, was one hundred-fold, but this is, of course, exceptional. In Dawson County, cultivated as wheat ordinarily is, the yield was thirty-five-fold. In Warren its yield was 50 per cent. more than that of other kinds, and better in quality. It is pronounced the best wheat in that section of country. In Johnson County, sowed in drills and manured with superphosphate of lime, it rusted badly, and was no earlier than some other varieties. In Clayton, Crawford, and Butts Counties, there is complaint of a little rust, but the yield and quality are generally stated to be excellent. In Clayton, with extra tillage, the yield was sixty-fold, and in Butts thirty bushels per acre. In Polk, Gordon, and Hall Counties the yield and quality are better than with the common varieties; and a Carroll County correspondent thinks it the best wheat ever introduced into the county, his crop weighing sixty-five pounds to the bushel, and making fifty-four pounds of flour, the best he ever used. In Gilmer County the yield is reported one-third more than that of the common kinds on the same land.

Returns from Clay County, Alabama, confirm the favorable reports

made on the Tappahannock wheat last year, published in the Annual Report. In Hale County this wheat rusted, and in Coosa it did not do well. In De Kalb it produced a good crop, which brought 75 cents per bushel more than other wheat, for seeding. In Elmore County it is claimed to be the best raised.

In Leake and Winston Counties, Mississippi, this wheat did well in 1868, and in Jackson County, in 1869, it produced twenty-two bushels where other kinds returned only eight bushels per acre, and the grain was the best ever grown there.

In Williamson, Grayson, Dallas, and Ellis Counties, Texas, it produces moderately well; but in Kendall, Lampasas, and Fannin Counties it has been affected by rust the present year. As the farmers of that State are anxious for some better variety of wheat than any they now cultivate, the resolution to test further the Tappahannock is expressed.

In Bedford County, Florida, the yield of this wheat is stated to be forty-fold, and equal in quality to the seed furnished. Its introduction there has created much interest among farmers, and has led to a great demand for the wheat for seed.

In Missouri this wheat appears to do better than in either of the Carolinas or Alabama. Howard, Phelps, and Stoddard Counties were noticed as favorable locations for its growth in the Report of last year. To these may be added Butler, Cedar, Hickory, Marion, Miller, Scott, St. Louis, and Washington, from which reports have also been received. In Butler the yield, from seed sown broadcast, was over twenty-four-fold, and the grain ripened ten days earlier than other wheat. In Cedar it thrives exceedingly well; in Hickory, from which the largest number of reports is received, it is preferred to any other for quality and early maturity; and in Marion it gives an average yield of thirty-five bushels per acre, and ripens with the Early May wheat, to which it is superior. In Miller and Scott Counties the yield is thirty bushels per acre, of the best quality. In St. Louis County it is called the best variety ever introduced into the State. In Washington it is said to be "admirably adapted to the soil and climate of Southeast Missouri." In Stoddard it is reported to yield thirty-five bushels per acre from less than a bushel (usually about three pecks) of seed to the acre.

In Western Arkansas this wheat yields, with good cultivation, twenty-five to thirty-five-fold, of excellent quality. In Yell County, sown beside a native variety and treated similarly, it returned twenty fold, superior grain, while the other gave but sixteen. Crawford County reports the yield and quality superior to those of the common kinds; but in Montgomery it is later than the Early May, and affected with rust. In Southern Arkansas it succeeds well, and is earlier than most kinds sown there. The yield is not so great as reported in Missouri, but the quality of the grain is stated to be uniformly superior to all other varieties grown.

Reports of the successful trials of this wheat in five counties in Indiana were published in the Annual Report of this Department for 1869. In those it was stated to be so early as to escape rust, except in Washington County, in the southern part of the State. Six other counties, mostly in or near the western border of the State, have reported. The average yield is over twenty-five-fold and the quality almost uniformly excellent. In Harrison County the millers are reported as offering 30 cents per bushel more for it than for other wheat, on account of its greater yield of flour and its quality; and in Vigo County it took the premium at the fair, a fact reported more frequently of this than of

any other variety. In St. Joseph County, at the extreme northern end of the State, it is ten days earlier than other varieties.

There are few favorable reports of experiments with this wheat in Illinois. In Fulton County several experimenters report the quality fine and the quantity satisfactory; and in a few other localities it does well. Some report a fair yield of flour, but of inferior quality. In all other States in which this wheat thrives ordinarily well the quality of its flour is classed as superior.

In Lapeer County, Michigan, the yield of this wheat is reported at twenty-four bushels per acre, weighing sixty-five pounds per bushel. In Schoolcraft the yield, in 1868, was thirty-two bushels per acre, while other varieties did not exceed twenty-five on like soil. In Ingham County it succeeded very well in 1868, and has not since been reported. In Bay County it is said to rust. In Oakland its yield last year was large, and quality excellent. In Hillsdale County, where it has been tested four years, it is claimed to be 100 per cent. better than the Treadwell wheat, considering the seed required, and yield per acre, and that it is not troubled by the wheat fly. It has proved valuable also in Marshall County.

Few reports have come from Kansas concerning the Tappahannock wheat. It is claimed to be the best grown in Cherokee County, and a report of its cultivation this year in Pottawatomie County states the yield to be forty-two bushels per acre, and weight sixty-five pounds. The reports are few, also, from other Western and Southern States.

In several counties in Iowa this wheat has failed on account of the severity of the winters, and sometimes from too late sowing. In Jackson County several farmers report successful culture, and express the opinion that under favorable circumstances it will prove there a very profitable winter wheat.

In Butte County, California, the Tappahannock continues to do well; and a similar report comes from Lassen County.

In Kane County, Utah, the Tappahannock does well, even without irrigation, which is seldom the case in that region. It is two weeks earlier than the ordinary kinds, and is in great demand for seed. From San Pete and other localities the reports are similar. It is liable to smut in Box Elder County, a drawback which is obviated by thorough wet-liming and immediate drying, about one month before sowing. In Lane County twenty-seven pounds of seed on half an acre of stiff clay land, without manure, produced, in 1869, twenty-four bushels of good, merchantable wheat.

In Weld County, Colorado, the Tappahannock, sown in February, yielded about thirty-five-fold. The Denver News recently reported the yield of four bushels sown upon four acres, irrigated twice, at one hundred and fifty bushels—thirty-seven and one-half bushels per acres. From the reports received it does not appear to yield more than some other varieties grown in the Territory.

MEDITERRANEAN WHEAT.

The Mediterranean wheat (both red and white) has been imported in small quantities several times, and distributed, since 1863. The importations were from Marseilles, France, but the grain was grown on islands in the Mediterranean Sea. It has flourished remarkably in many sections of this country, though not so widely as the Tappahannock. In some portions of Virginia it has done better than other varieties; as also in New York, West Virginia, Missouri, Mississippi, Maryland, Ohio, and California, proving most profitable in the last three named.

There is some complaint of the deterioration of seed from old varieties, and there are calls for fresh importations and for new varieties. A Logan County, Ohio, correspondent writes to the Department that the seed of this variety is failing, the yield rapidly decreasing, and that the famous Mediterranean wheat, which has been worth millions of dollars to the farmers of Ohio, is fast running out.

There is no complaint of deterioration in California, in some parts of which State this wheat is considered very valuable. From Stanislaus County a farmer writes that the wheat received from this Department in 1865 increases in favor wherever planted. The yield of 1868 was an average of thirty-seven and one-half bushels per acre, and would have exceeded that had not some of the seed been destroyed by excessively wet weather. He considers the variety a great acquisition. From San Joaquin County a yield of four hundred and twenty-eight bushels upon eight acres in 1868 is reported, nearly fifty-four bushels per acre. In 1869 the yield was not so large, but ten bushels per acre greater than that of other varieties under similar circumstances.

In Owsley County, Kentucky, where but little has been sown up to the present time, it is reported to yield forty bushels per acre. In Shelby County, Alabama, a correspondent states, it is decidedly the best variety, and preferable for the middle portion of that State. In the region of Harrison County, Indiana, it is the principal variety raised, but is later than the Tappahannock.

In Maryland it is "the champion wheat." It is stated that too thick seeding and want of care in the selection of seed have resulted in deterioration.

In Chautauqua County, New York, this wheat has had a fair trial by numerous farmers, and has proved the best variety for that section. In 1869 a great quantity of it was reported sown and thriving, but no reports have since been made concerning it. The same may be said of Suffolk County.

TALAVERA, POLISH, TOUZELLE, AND ROUGH-CHAFF VARIETIES

have proved valuable accessions in some localities, but comparatively few reports concerning them have yet been made. The Touzelle was imported and distributed in 1869, the others in 1868. They are still on trial only, but sufficient information has come to the Department to indicate that the Touzelle, at least, will prove valuable over a wide region of country, and the others, like the Mediterranean, in perhaps more limited regions.

ARNAUTKA WHEAT.

Of the varieties of spring wheat distributed by the Department, the Arnautka, imported from Russia in 1866, has proved most successful, and is found to be as valuable an addition to the spring as the Tappahannock is to the winter varieties. It is early, hardy, and prolific, and yields a good quality and large quantity of flour, and for these reasons is peculiarly acceptable in the colder latitudes. In some regions the product has greatly improved in the size of the kernel upon the seed furnished, as in New Mexico and Nebraska; while in others, where it proves thrifty, it has nearly or quite maintained the quality of the original.

A farmer in Hancock County, Maine, writing to the Department, states that the Arnautka is peculiarly adapted to the soil and climate of that State, and that the quality of the wheat is remarkably good. The yield was at the rate of sixteen bushels per acre. In Piscataquis

County it did not do very well the first year of its trial. on account of wet weather, but faith in its ultimate success created a demand for the product saved, for seed. In Alexander, Washington County, both yield and quality are reported good. In Aroostook County it matured a week earlier than other spring wheat, yielded one-third more under the same conditions of culture, and was free from the weevil. In York County it yielded eighteen bushels per acre, four bushels more than other wheat. In Sagadahoc, also, it is a week earlier and yields twenty bushels per acre. In Penobscot the yield this year was twenty-two bushels per acre, and the variety is commended as very early and the best wheat ever seen there.

In Carroll County, New Hampshire, it yields on ordinary land, with the usual cultivation, about sixteen bushels per acre, and is "not troubled with mildew, blight, or weevil." In Sullivan County, also, it does very well.

In Addison County, Vermont, it yields well and escapes the midge. A correspondent states that if it continues to do as well as now, it will be as valuable to that section as was the Black Sea wheat. In Orleans County, on the Canadian line, it has proved early, hardy, and free from disease, and is commended as the best spring variety.

In Hampden County, Massachusetts, the Arnautka is very thrifty. A farmer writes that he esteems it the best suited to that climate of any spring wheat in use, and thinks it may ultimately rank with the first class of winter wheats. In Middlesex County it is finer and larger than other varieties.

No favorable reports are received from the other Eastern States, and from only Jefferson County in New York, where it is considered a valuable acquisition.

In Illinois, Wisconsin, Kansas, Nebraska, and Iowa, the reports, though not numerous, indicate that the Arnautka is productive and valuable. In Nevada, Minnesota, and portions of Iowa, it is exceptionally so, the yield, in some instances, being as high as sixty-fold.

A Wabashaw (Minnesota) correspondent reports that thorough tests during four years prove it to be superior to any other spring wheat in the West, millers declaring its flour to be worth 25 per cent. more than that of the varieties in general cultivation. From Brown County it is reported the present year that the Arnautka has been grown by many farmers, and in every instance has yielded a heavy crop, averaging a bushel of wheat to a pound of seed. In Faribault County it has "proved a great yielder, and makes a large quantity of flour."

In Greene County, Wisconsin, the yield was double the quantity of the winter wheat and of good quality.

Recent reports of cultivation of the Arnautka in 1868 and 1869, in Kossuth County, Iowa, state that, though both seasons were unfavorable for wheat, the yield was large and the grain superior.

In Peoria County, Illinois, it is reported to make more and better flour than any other wheat.

In Sedgwick County, Kansas, the yield has been at the rate of fifty bushels per acre the present year. Its introduction into Nebraska has been attended with profitable results.

OATS.

Eight varieties of oats new to this country have been introduced and distributed by the Department during the last five years, viz: Potato and New Brunswick oats, from Scotland, and White and Black Swedish, from Denmark, in 1865; Excelsior and Somerset, from England, and

White Schönen from Germany, in 1868; and Scotch Dun oats, from Scotland, in 1870. The latter are a winter variety, and of course have not yet been reported upon. All the other varieties named have proved valuable, the Excelsior and White Schönen remarkably so. The Excelsior have been found suited to a wider region and greater diversity of soil and climate than any other imported variety, are the earliest, and have proved most popular and remunerative. They originated from the Somerset stock, and may be classed as an identical variety; but they have been so improved by careful special culture as to be worthy the distinction of their separate name.

As with the trials of other seeds some reports upon these several varieties of oats have been highly favorable, while others record partial or total failures, due, in many instances, to unfavorable seasons, to faulty culture, &c., and in others to the want of adaptation of the grain to the region.

POTATO OATS.

The Potato oats, after four years' trial in Marshall County, Michigan, are reported to be a decided improvement over the common varieties, and, in 1869, weighed forty-five pounds per bushel, common oats weighing twenty-eight to thirty-two pounds. In La Crosse County, Wisconsin, a correspondent reports that the present year these oats produced at the rate of seventy-two bushels from one bushel of seed, sown by drill. In Ashtabula County, Ohio, sown in drills eight inches apart upon turf, the yield was one hundred and fourteen-fold, and in quality far superior to any oats ever grown in that vicinity.

NEW BRUNSWICK OATS.

A report from Washington County, Pennsylvania, states the result of three experiments with the New Brunswick oats, commencing with one pint of seed from the Department, to be, the third year, three hundred bushels of excellent oats, weighing forty-five pounds per measured bushel, upon six acres of land, broken and planted with corn the previous year. About fifty bushels were lost by the ravages of grasshoppers before harvest. This is over fifty-eight bushels per acre of very heavy oats. From Ottawa County, Michigan, the yield is reported to be fifty to sixty bushels per acre, and the weight forty-two pounds per bushel. The secretary of the Sibley County, Minnesota, Agricultural Society reported, in 1869, a yield of forty-five bushels per acre, and forty-seven pounds to the measured bushel.

SWEDISH OATS.

The White Swedish and Black Swedish oats, the former procured in Hamburg, Germany, and the latter in Copenhagen, Denmark, have in very many cases been reported upon without any distinct designation of their kind, being classed merely as "Swedish," although they are distinct varieties. Such reports are not available in this article. Both varieties have proved profitable additions to our cereals in many localities, while in others they have failed to be more remunerative than other oats. The Black Swedish are reported to be subject to rust in some localities in Connecticut and Wisconsin. In Dauphin County, Pennsylvania, they are stated to be superior to other varieties. In Denver, Colorado, two bushels, drilled upon two acres and irrigated twice, yielded one hundred and sixty-six bushels. They are hardier, and withstand spring frosts better than common oats in that section. In San Pete County, Utah, the yield has been at the rate of eighty bushels per acre

the present year. In McLeod County, Minnesota, they have done well, yielding more per acre than other oats, by measure, and being five to twelve pounds heavier per bushel. In some portions of Kansas they are said to yield remarkably well, and in Paoli, Orange County, Indiana, the excessive yield of one hundred and twenty-four bushels per acre is reported.

The White Swedish, in York County, Maine, after four years' trial, yield thirty-five bushels, of thirty-eight pounds, per acre—better yield and weight than of other varieties there. They were reported in 1868 and 1869 by various farmers in Broome County, New York, as superior. In 1868, although a dry season, the yield was good, and weight thirty-nine pounds. In 1869, after three years' trial, they are found to suit that locality well, and weigh forty pounds per bushel, growing beside other oats which weigh only thirty pounds. The secretary of the Broome County Agricultural Society reports that "they grow well, do not deteriorate in the least, and though many members have them, they can scarcely supply the demand for seed." In Dauphin County, Pennsylvania, it is stated "no better variety could be wished for, as they are remarkably fine, yielding largely, and weighing nearly forty pounds to the bushel." In Lawrence County the yield was fifty-six-fold in measure and weight. In Mercer County, Ohio, they are reported "a great success, ripening earlier, producing more bushels, and weighing one-third more than common varieties." A Brown County correspondent writes that a pound of White Swedish oats, received from the Department, produced seven bushels, weighing forty-five pounds per bushel. After two years of cultivation, he found the quality equal to the original, weighing forty-five pounds, and yielding largely to the acre. The straw is very strong, standing up well against storms and wet, and he thinks the variety admirably adapted to that climate.

WHITE SCHÖNEN OATS.

These oats have proved productive and profitable over a wide region, and the favorable reports noted last year are fully confirmed by later returns from the localities then reporting. In Onondaga County, New York, the present year, the yield is eighty-five bushels per acre; in Sussex County, New Jersey, fifty to sixty bushels, weighing forty pounds per bushel. The secretary of the county agricultural society, who makes the report, says: "We hope to have enough seed to supply Sussex County, as these Schönen oats appear destined to supersede all others." In Washington County, Pennsylvania, the yield this year is reported to be sixty-four bushels per acre. In Dauphin County they are stated to be remarkably fine, to yield largely, and weigh nearly forty pounds per bushel. A Mercer County correspondent states that their quality is very superior, that they seem peculiarly adapted to Northern Pennsylvania, and that "in an ordinary season, with good farming, they will easily produce seventy-five to one hundred bushels per acre."

In Baltimore County, Maryland, the second sowing from a quart of seed furnished by the Department produced forty bushels the present year. The reporter says: "This variety is superior to our common oats, having stiffer straw and larger head, and yielding more bushels to the acre and of better quality." In Princess Anne County, Virginia, they are stated by one farmer to be superior to any others raised in the county, and by another the yield is reported to be twenty-five-fold, as good as the seed sown. The secretary of the farmers' club in Lee County, West Virginia, reports a yield of about thirty-fold. In Fond du Lac County, Wisconsin, they are prized on account of their stiff

straw and good yield; and in Rock County, where the Black Swedish were ruined by rust, the Schönen were not affected. Also in Bay County, Michigan, where the former did not succeed, the latter did remarkably well, the straw being very stiff, the heads large, and the oats weighing forty-six pounds to the bushel.

In Crawford County, Illinois, the Schönen oats rusted on account of lateness, a fact sometimes mentioned in other reports. In Whitesides County their quality, in 1869, was excellent, and they yielded at the rate of seventy-five bushels per acre; in Macoupin, seventy bushels. In Miami County, Kansas, sown broadcast, the yield was sixty-fold, but the weight not much greater than that of common oats. In Nemaha County the yield was sixty-four-fold and the grain excellent. In Riley County, also, the yield was large. In Stone County, Missouri, it was forty-fold, rather better than the Black Swedish. In Brown County, Minnesota, they are reported a valuable acquisition, well adapted to the soil and climate, and much superior to the oats usually raised there, being heavy and yielding abundantly.

In Clayton County, Iowa, the yield of common oats was ten-fold, as reported by one farmer, while the yield of this variety, similarly treated, was thirty-two-fold, quality good, and kernels large. In Whatcom County, Washington Territory, from seed drilled in, the yield in 1869 was sixty-four-fold and weight thirty-six pounds per bushel, as reported by the secretary of the agricultural society.

The Somerset oats in Orleans County, Vermont, ripened ten days earlier than other kinds the present year, and were very heavy. In Susquehanna County, Pennsylvania, the yield on a creek flat was eighty-fold, and weight forty pounds per bushel. In the District of Columbia the yield was forty-four-fold and weight thirty-eight pounds per bushel, other oats weighing twenty-six pounds. In Huntingdon County, Indiana, the yield is reported at eighty bushels per acre, and weight forty-five pounds. These were the premium oats at the annual fair in this county in 1869. In Clarke County the yield and weight of grain are reported to be heavy, and the straw tall.

EXCELSIOR OATS.

No other variety of oats introduced into the country has proved equal to the Excelsior in weight, yield of grain, and adaptability to a great diversity of soil and climate. The yield of straw is also heavy, and when not too thickly seeded, and grown upon soil not too rich, they stand up well. The reports of experiments show that the thinnest seeding has produced the greatest yield and heaviest grain. Their tillering is remarkable, as many as twenty stalks having originated from one seed. The reports upon the Excelsior oats given in this article, as in the case of other grain noted in the Annual Report of 1869, are additional to the reports published in that volume.

In Penobscot County, Maine, the Excelsior were ten days earlier than other varieties, the yield about forty-fold, and the grain weighed forty-four pounds per bushel; they did not rust. In Kennebec County the yield was forty-fold. Our correspondent says they grew six feet high, the yield was about four times that of the common varieties, and he considers them superior to any other variety he has raised. In Cumberland County the yield was twenty-four-fold, and the oats matured two weeks earlier than other oats, from Canada, grown beside them, and were much heavier. At Brunswick, in the same county, the yield was thirty-three-fold, grain full and plump as barley, and fit to cut five days earlier than other oats. At Richmond Corner, Sagadahoc County, the

yield was forty-fold of grain much heavier than the common oats, and also five days earlier. In Bowdoinham, in the same county, they stood five feet high, and are pronounced "the best oats ever seen in the town."

In Hillsborough County, New Hampshire, the yield was over forty-five-fold, and the grain superior. In Carroll County the yield this year was good, and the weight forty pounds per bushel. In Merrimack County the yield was twenty-eight-fold, and the grain, thoroughly cleaned, weighed forty-six pounds per bushel. They took the diploma at the New Hampshire State Fair in 1870.

In Windham County, Vermont, these oats were experimented with by many persons, and in every case the yield was good, and the grain large and heavy. Some of the heads were twenty inches long, and the straw was of excellent quality. In Randolph, Orange County, one farmer reports the yield about forty-fold, and the weight of grain forty-one pounds per bushel; in another instance, the weight of the grain was forty-three pounds.

In Queens County, New York, the Excelsior matured eight days earlier than other oats, and yielded forty-three bushels per acre, the seed drilled in. In Winchester County the yield was thirty-five bushels per acre, thirty-five pounds per bushel, and the straw was strong, high, and double that of other oats in quantity. The oats were also two weeks earlier than other kinds. In Jefferson County the yield, reported by the secretary of the county agricultural society, was forty-three-fold, and quality superior. In Oneida County, upon land not the best for grain, the weight of the oats grown was forty pounds per bushel, the average weight of common oats grown there being less than thirty-two pounds. In Cortland County the yield this year was at the rate of thirty bushels per acre, and weight over thirty-five pounds. In Washington County they are reported to be "the best, brightest, heaviest, and have the evenest kernel of any oats ever introduced" into that section of the country; yield, sixty-five bushels per acre.

Several experiments were reported in 1869 from Dauphin County, Pennsylvania, by Hon. R. J. Haldeman, of an increase of nearly two hundred-fold. This yield is the largest yet reported, and remarkable even in limited experiments under the most favorable circumstances. The yield in Tioga County is reported at ninety-fold, the grain weighing forty and one-half pounds per bushel; in Cumberland County one hundred and thirty-six-fold, weight forty-five pounds per bushel. In Chester County, it is stated, they are "early, handsome, and heavy."

In Talbot County, Maryland, sown broadcast on rich land, without manure, the yield was twenty-four-fold, and weight forty-five pounds per bushel. In Kent County, upon land thinly seeded, the yield was seventy-five-fold, weight forty-five pounds.

In Erie County, Ohio, from seed drilled in, the yield was over fifty-seven-fold. In Cuyahoga about twenty-fold, and weight forty-two pounds. In Trumbull County the yield was sixteen-fold, weight forty-two pounds. The results of four experiments in Hamilton County are reported by Mr. J. S. Sheppard, and are respectively thirty-eight, forty-two, thirty-six and forty-four-fold. The secretary of the Stark County Agricultural Society reports the yield seventy-fold, and the quality as good as that of the seed sown.

Hon. John Pool, of North Carolina, in a letter of August 10, 1870, says that the product of four quarts of Excelsior oats was seven and one-half bushels, weighing thirty-seven pounds to the bushel, and that the oats have attracted a great deal of attention in the neighborhood, being the finest ever seen there.

In Keweenaw County, Michigan, these oats are plump and heavy, and mature much earlier than common oats, the correspondent adding that they promise great improvement, in early maturity, quality, and quantity, over anything raised there. In Jackson County the yield was fifty-nine bushels per acre, and the crop matured early. John F. Van de Vante, of Sturgis, St. Joseph County, reported on the 1st of October, 1870, that from a package of Excelsior oats, received from this Department the preceding year, he raised two bushels, which this year produced one hundred and twenty-five bushels, weighing forty-four pounds to the bushel. He thinks this variety better adapted to that climate than any he has seen.

In Fond du Lac County, Wisconsin, the Excelsior oats yielded over fifty-eight bushels per acre, by measure, weighing forty-nine and one-half pounds per bushel. In Adams County, drilled in, on sandy loam, the yield in one instance was one hundred and forty-two-fold, and the weight forty-two pounds per bushel. In Oconto County the yield was sixty bushels per acre, and weight forty-four pounds. In Waupacca County the yield was large, and weight, in 1869, forty-six pounds, and in 1870 forty-seven pounds per bushel.

In Hamilton County, Illinois, they weigh forty-one pounds per bushel. In Champaign County the yield was about twenty-seven-fold in 1869, and the grain heavy.

From Terre Haute County, Indiana, the secretary of the Henry Creek Agricultural Society writes that the Excelsior oats raised from the seed received from the Department took the premium at the county fair, and that the grain was fully equal to the original seed.

In Cole County, Missouri, the Excelsior oats are pronounced much superior in grain and length and strength of straw to other varieties cultivated beside them. They were the premium oats at the county fair in 1869. In Phelps County the yield was thirty-two-fold; weight, forty-six pounds.

In Cherokee County, Kansas, though affected in some localities with rust, they yielded better than the common varieties.

In Sibley County, Minnesota, these oats are about eight days earlier than other varieties, and are reported to yield eighty bushels per acre.

In Wayne County, Iowa, they are classed as superior; in Dallas County the yield is large, and the weight of grain forty-five pounds per bushel; and in Humboldt the yield is stated to be eighty-fold.

In San Pete County, Utah, they are considered "a great acquisition, and weigh eight to ten pounds heavier than other oats."

The secretary of the Oregon State Agricultural Society reports that of the various grains tested on his own farm, the Excelsior oats proved superior, and seem well adapted to that State.

VEGETABLES, PLANTS, ETC.

A larger proportion of the reports of experiments with field and garden vegetables, plants, and grasses has been received from Southern and Western States; but of all reports made, few are here used or can be made available, as few furnish statements which permit a comparison of their value with varieties already in general cultivation. In many localities, however, the seeds distributed have proved of especial value, introducing new plants into suitable localities untried before, or superior varieties of kinds already cultivated; and frequently, as was expected, the mere change of seed has resulted in increased production.

In some portions of Texas the Russian turnip has proved a valuable acquisition, surpassing all others in flavor. The Orange Globe mangel-

wurzel has taken rank as the earliest beet in Ellis County, and Cook's Favorite as the best tomato. In Austin County Carter's Early peas, planted the 9th of March, matured sufficiently for table use the 28th of April. The White Japan muskmelon is reported the best ever raised in Anderson County; and in Austin the Sprouting Dwarf Ulm cabbage gave two crops, the first heads having been cut off, and heads seven inches in diameter maturing from new sprouts.

The Pine-apple beet is reported by a market gardener in Lewisburg, Ohio, to be the most satisfactory of any raised by him, being as early as the Bassano, hardy, of the finest flavor, and an excellent keeper.

In Dresden, Tennessee, the American Drumhead cabbage has surpassed other kinds, and the Salmon radish, in Marion, Alabama.

In Drew County, Arkansas, the White Japan muskmelon is reported to be the sweetest and best-flavored variety known there.

In Delaware County, Iowa, the Scarlet White-tipped radish, Early Nocera onion, Mountain Sprout watermelon, and Vilmorin's improved sugar-beet, proved the best of their respective varieties; and in Rock Island, Illinois, as reported by the gardener of the arsenal, the Student parsnip, said to have originated there, the Early Nocera onion, and Tilden tomato, are superior varieties. The onions were fully ripe four months after seed-sowing.

The Scarlet radish was fit for the table in Jefferson County, West Virginia, thirty-seven days after sowing.

In Grant County, Kentucky, Rock County and other portions of Wisconsin, and Humboldt County, Iowa, the Schweinfurt Quintal cabbage grew very large, crisp, and tender. In the latter county the average weight is stated to be twenty pounds each. In Glencoe, Minnesota, they grew nearly to the size of a bushel basket; and in Milford, New Hampshire, they weighed twelve to twenty pounds. In Lewis County, New York, the greatest size is reported, the average weight being about twenty pounds, and one, exhibited at the county fair in 1869, weighed forty pounds.

In St. Louis, Missouri, the Leviathan White celery is reported crisp and tender, and some of the stalks grew six feet long.

The New Jersey Hybrid cucumber proves very prolific in Liberty County, Georgia, excellent in flavor, and measures 13 to 15 inches in length. In Hampton, Virginia, this variety does equally well.

In Merrick, Nebraska, the Achapesnorricher melon proves very delicious, equal, at least, to the Cassaba melon; and in Chico, California, its flesh is solid, thick, and very fine in quality; small melons weighed sixteen pounds; seed cavity small.

In Stoughton, Wisconsin, a change of seed of the Connecticut seed-leaf tobacco, the fresh seed grown in alternate rows with the same variety grown there for some years, produced a larger crop and of better quality. The difference in favor of the new seed was perceptible all through the season.

The jute plant is now being cultivated at St. Augustine, Florida, from seed furnished by the Department, and also in other localities along the Gulf. Egyptian cotton-seed in Florida, Texas, and Mississippi, has done well in the cases which have been reported. An old planter in Warren County, Mississippi, thinks it would make 1,200 to 1,500 pounds per acre, under favorable circumstances, and says it has the finest lint and best staple he ever saw.

The ramie plant *(Bœhmeria nivea)* or the China grass of commerce, cultivated in many parts of the South, from seed furnished originally through this Department, is found well adapted to that portion of the

country, and when it can be utilized cheaply it may become a staple crop. It multiplies very rapidly from root-planting, one hundred roots having in one year produced plants enough for over one hundred and fifty acres, as reported from Louisiana. In Fayette County, Tennessee, it grows very thriftily, and produces a beautiful, glossy fiber. In Goliad, Texas, it grows well both from seeds and roots; and in Austin the staple is reported long, fiber excellent, white, and silky.

From Baton Rouge, Louisiana, and Bel Air, Georgia, reports concerning the successful growth of the Tea plant have been received, and occasional calls upon the Department for seed show an interest in efforts for native tea production. In the localities named it is said that the plants grow finely, and the flavor of the tea produced is equal to that of the tea of China. A correspondent in Louisiana says that the tea plant *(Thea viridis)* grows well in that State, and that one of the members of his agricultural association has between three hundred and four hundred fine shrubs four and one-half to six feet high.

The introduction of several varieties of clover has been attended with satisfactory results in various localities. This is especially true of the Alsike clover, reports upon which have been noted from time to time in the monthly and annual reports of the Department. Lucern *(Medicago sativa)* grown near Columbia, South Carolina, from seed furnished by the Department, is reported as growing finely, and "one of the very few grasses that will grow" there. W. S. Monteith, of Columbia, says: "In all the upper counties of this State it would be of very great value, if largely planted to take the place of clover."

MINOR VEGETABLE PRODUCTS AND THEIR SOURCES.

The introduction of new industries is, at all times and in all countries, a matter of special interest of a two-fold character—the direct addition to the industrial and wealth-producing resources of a nation, and the indirect value that is certain to follow a system of rotative cropping and diversity of culture, in maintaining the fertility and economical management of the soil. The inducements for further efforts in this direction, and the stimulus to new trials, become clearly apparent when we reflect upon the fact that, with the exception of tobacco and Indian corn, all of our cultivated field crops and most of our esteemed esculent vegetables are of foreign origin.

This Department has actively stimulated experiments and tests of new plants, and responded to repeated inquiries in this direction. Fruits, fibers, gums, dyes, and medicinal products, which have not been thus far the object of productive industry in this country, can be profitably introduced, as many have been, through the agency of this branch of the Government. It is not maintained that all the plants named in this article can find in this country the conditions most favorable to their growth or to their profitable production if easily grown.

The theory of acclimatization of plants, although a subject frequently alluded to, has no tangible support or foundation on facts. A species is either fitted or unfitted, either hardy or tender, in any given climate or locality. It is a question to be decided by experiment. The most popular system of so-called acclimatizing is by sowing seeds of successive generations, with a view of rendering the offspring better suited to the

altered conditions, but experience seems to prove that no permanently useful result has been obtained by this course. Individual plants may be influenced, to a certain extent, by local causes of soil and climate; but the capacity of a species to resist heat or cold, aridity or moisture, remains unaltered. This is well exemplified in the case of the tomato, which, although it has been cultivated for one hundred years, and generation after generation has been raised from its seeds, is still as easily affected by cold as it was when first introduced into cultivation.

The external appearance of a plant affords but little assistance in determining its climatic nature. There are, however, certain observable features that may be noticed. Plants having an abundance of expansive foliage, as some palms, musas, &c., are natives of a humid atmosphere. Asiatic plants have been noted for their beauty; African, for their fleshy and succulent leaves, as the aloes and mesembryanthemums; American, for the smoothness and length of their foliage, and for the singularity of shape of their flowers and fruit. Plants indigenous to polar and mountainous regions are generally low, with small and compressed leaves, but with flowers large in proportion. Australian plants are distinguishable for small, dry, and shriveled leaves. In Arabia they are low and dwarfish; in the Indian Archipelago generally shrubby and furnished with prickles; while in the Canary Islands many, which in other countries are merely herbs, assume the appearance of shrubs and trees. The shrubby plants of the Cape of Good Hope and Australia exhibit a striking similarity, as do also the shrubs and trees of the northern parts of Asia and America, which may be exemplified in the *Platanus orientalis* of the former, and in the *Platanus occidentalis* of the latter, as well as in the *Fagus sylvatica* and *Fagus ferruginea*, or *Acer Cappadocium* and *Acer saccharinum*, and yet the herbs and undergrowth of the two countries are very dissimilar.

A knowledge of the native country of a plant is not always sufficient information regarding its powers of endurance. The mere fact that a plant is a native of China, or that it comes from South America, will not in itself enable us to assign a limit to its climatic range; as we have plants from both these countries which are capable of resisting a zero cold, while we have others from the same places which would be killed if subjected to a temperature of 32°. Temperature is the grand regulating condition, and as this is affected by elevation as well as by increase of latitude, we find the mountain ranges near the equator presenting all the features of a tropical, a temperate, and even an arctic vegetation. Thus palms and plantains luxuriate at the bases of these tropical mountains. Above these appear oranges and limes; then succeed corn and wheat; and still higher commences the series of plants peculiar to temperate regions. Similar phenomena present themselves in temperate latitudes. "We may begin the ascent of the Alps, for instance, in the midst of warm vineyards, and pass through a succession of oaks, sweet chestnuts, and beeches, till we gain the elevation of the more hardy pines and stunted birches, and tread on pastures fringed by borders of perpetual snow. At the elevation of 1,950 feet the vine disappears; and at 1,000 feet higher the sweet chestnut ceases to thrive: 1,000 feet farther up, and the oak is unable to maintain itself; at an elevation of 4,680 feet the birch ceases to grow; and the spruce fir at the height of 5,900 feet, beyond which no tree appears. The *Rhododendron ferrugineum* then covers immense tracts to the height of 7,800 feet, and the herbaceous willow creeps 200 to 300 feet higher, accompanied by a few saxifrages, gentians, and grasses, while lichens and mosses struggle up to the imperishable barrier of eternal snow."

Humboldt has given a sketch of the vegetation of the Andes, commencing at the level of the ocean and extending to the highest summits. A condensed view of this sketch may serve as a general illustration of the distribution of plants as influenced by climate, arising from altitude above the sea level.

1. *Tropical zone, or region of palms.*—This region stretches from the level of the ocean to the height of 3,000 feet. Here flourish the magnificent family of palms, odoriferous and balsamic plants, the family of *Scitamineæ*, laurels, mimosas, the sugar-cane, coffee-plant, and indigo.

2. *Temperate zone.*—Above the region of palms is that of the tree ferns and cinchonas, the caoutchouc tree, camphor shrubs, passion flower, and a variety of useful and beautiful plants. At 8,000 feet is the region of oaks. Here also grow wheat, barley, oats, and the fruit trees of Europe.

3. *Alpine zone.*—From 6,000 to 12,000 feet extends the region of Alpine plants. Here flourish the ranunculuses, gentians, and a variety of hardy plants.

4. *Arctic zone.*—At the height of 15,000 feet all flowering plants disappear, and lichens alone clothe the rocks and ground. Some of these appear to vegetate under the snow, for, at 16,800 feet, near the summit of Chimborazo, the *Umbilicaria pustulata* and *Verrucaria geographica* are seen growing on a shelf of rock; and these were the last organized substances adhering to the soil at so great a height which Humboldt and his companions were able to discover.

5. *Snowy region.*—The last region is that within the line of perpetual congelation, where eternal ice and snow hold their dominion.

De Candolle calculated that in France every 540 feet of vertical elevation are equivalent to a receding of one degree from the equator, while Humboldt estimated that in tropical countries every rise of 396 feet is equal to one degree of latitude north. Meyen, in his division of the horizontal range of vegetation into zones, extends:

1. The equatorial zone to 15° on both sides of the equator. In this division we find the Cape Verde Islands, Sierra Leone, Ascension, and St. Helena, the republic of Liberia, the settlements in the Gulf of Guinea; and, on the western coast of Africa, Abyssinia, Zanzibar on the east coast, Mocha and Aden in the Red Sea, the northern portion of Madagascar, the Seychelles, Northern India, Ceylon, and the Nicobar Islands, Sumatra, Siam, Malacca, Singapore, Cochin China, the Philippine Islands, Borneo, Celebes and Moluccas, Java and Madura, Banca, the Johore Archipelago, Timor, and the eastern group of islands, with New Guinea, a large portion of Northern Australia, the Marquesas, Society and other oceanic islands. In South America we find Peru, Bolivia, Ecuador, New Granada, and Venezuela, Guiana, and a large portion of Brazil, Trinidad, Barbadoes, and most of the islands in the Caribbean Sea. This zone has a mean temperature of 78½° to 82½°.

2. The tropical zone reaches from the 15th degree on each side of the equator to the tropics, in 23° latitude. The mean temperature is 73½° to 82½°; summer temperature 80° to 86°; winter temperature in the eastern coast districts, 59°. In this region we find the following countries: The Sandwich Islands, Canton in the province of China, Burmah, Calcutta, Bengal, Bombay, Madagascar, and Mauritius; the southern portion of Brazil, Cuba, San Domingo, Mexico, and Central America.

The sub-tropical zone extends from 23° to 34° of latitude. A number of tropical fruits may be found in this region. The winters are mild, and vegetation is green throughout the year. In the northern division of the zone palms and bananas grow on the plains. In this

region are comprised all the extreme northern portions of Africa bordering upon the Mediterranean, and comprising Algiers and the Barbary States, Egypt, part of Persia, Cabool, and the Punjab; the greater portion of China, Lower California, Texas, the Southern States of North America, the Bermudas, the Cape Colony and Natal, New South Wales, Southern and Western Australia, Northern New Zealand, the larger portion of Chili, Paraguay, Uruguay, and the Argentine Republic, the provinces of Brazil from St. Paul to Rio Grande, Madeira, and Canary Islands. Thus it appears that, in regard to the geographical distribution of plants, altitude and latitude are synonymous terms within specified zones; and that next in importance to the introduction of a new plant is a knowledge of its habitat; the altitude, exposure, and physical surroundings of its original home; and that botanical collectors should be strongly impressed with the value and necessity of minute details in these particulars.

For some time past the correspondence of this Department has indicated that a brief notice of the sources of commercial vegetable products would be desirable. In accordance with this intimation, the following notes have been prepared on oils, gums and resins, tea and other products from which beverages are made, spices and condiments, and vegetable waxes; to be followed in future Reports with similar notes on fibers, dyes, medical extracts, fruits, &c., if found desirable.

OILS.

Gingelly oil, *Sesame oil*, *Teel oil.*—This oil is expressed from the seeds of *Sesamum Indicum*, (*Pedaliaceæ*,) a free-growing annual plant, indigenous to the East Indies, but extensively cultivated in Japan and other sub-tropical countries. A large commercial business is carried on in the growth, manufacture, and trade in this oil, which is as clear and sweet as that from almonds, and as tasteless as that of the olive. It is often used to adulterate the former, and when carefully expressed is employed as a substitute for the latter. In Japan it is used in cooking fish, and the Egyptian ladies consider it of value for the toilet, to give a bloom and luster to the skin, and to preserve the beauty of the hair. It is sufficiently pure to admit of being made the medium of extracting perfumes. Much difference of color is observed in imported samples, which is entirely due to the preparation. When the seeds are thrown into the mill without first undergoing any cleansing process, the expressed oil becomes mixed with a portion of the coloring matter of the epidermis of the seed, and is much inferior to that obtained by repeatedly washing the seeds in cold water, or by boiling them for a short time until the whole of the reddish-brown coloring matter is removed, and they become white. They are then dried in the sun, and the oil obtained is of a very pale straw color, of agreeable odor, and but little inferior to olive oil. The *Sesamum* is frequently cultivated here for its leaves, under the name of the bene plant. The leaves are mucilaginous in water, and are used to alleviate summer complaints in children. This plant ripens its seeds in most of the Middle States, and in all the Southern, and is certainly worthy of attention as an article of produce. The seeds contain 45 per cent. of oil.

Croton oil is extracted from the seeds of *Croton tiglium* (*Euphorbiaceæ*,) an evergreen tree, growing 15 to 20 feet in height, a native of the East Indies. It is prepared by reducing the seeds to a powder, which is placed in bags, and pressed between iron plates. The oil is allowed to stand fifteen days, and is then filtered. The residuum is saturated with

twice its weight of alcohol, heated to 140°, and the mixture pressed again. The alcohol is afterward removed by distillation. The oil is a very active purgative, very acrid, and dangerous, unless carefully administered. Even those employed in preparing and pressing the seeds are affected with irritation of the eyes, and violent purging.

Oil of Thyme, or Origanum.—The wild marjoram, *Origanum vulgare*, (*Labiatæ*,) a low-growing herb, originally from the Mediterranean, but introduced and occasionally found wild, yields an acrid stimulant oil, known as oil of thyme. It is used as a caustic. The native horsemint, *Monarda punctata*, yields an aromatic oil, which is also known as origanum. It is used successfully as a counter-irritant in cases of deafness.

Citronella oil is obtained from the lemon grass, *Andropogon schœnanthus*, (*Andropogoneæ*,) a native of Malabar, much cultivated in the East and West Indies and in parts of South America, both for the refreshing fragrance of its leaves and the essential oil which they contain. This oil is largely exported from Ceylon, and is used in medicine and perfumery.

Cajeput oil.—This volatile oil is obtained from *Melaleuca minor*, (*Myrtaceæ*,) an evergreen shrub, native of the Moluccas and other Indian islands. The oil is extracted by distillation of the leaves after fermentation. It is of a greenish color, and has a powerful aromatic odor, and at one time was thought to be of special value in cases of cholera. It is an antispasmodic and stimulant. The leaves are used in China as a tonic in the form of decoction.

Carap or Crab oil.—This is produced from the seeds of *Carapa Guianensis*, (*Meliaceæ*,) a tree growing 60 to 80 feet in height, native of the West Indies and Guiana. The fruit is large and contains numerous oily seeds. The oil is extracted by pressure, and is used for burning in lamps. It is also much esteemed in Demerara and Trinidad as an unguent for the hair; also for applying to the wounds of animals, and for destroying ticks and other insects which infest cattle. In cool, temperate climates it hardens into a solid fat.

Hundoo or *Tallicoonah oil* is obtained from *Carapa Guineensis*, a tree very similar to the last, a native of Senegal. This oil is also used for burning, and is held in high estimation as an anthelmintic. It is entirely soluble in ether, and alcohol separates it into two parts, a concrete substance and an oil fluid. The former contains the bitter principle and the nauseous odor of the oil. Its bitterness is traced to an alkaloid principle which has also been found in the bark.

Poonga oil is expressed from the seeds of the *Pongamia glabra*, (*Leguminosæ*,) a tree widely distributed throughout the East Indies, Southern China, and North Australia, and which might be grown in the Southern States as a shade tree. The oil is used for burning, is of a pale brownish color, and is fluid at a temperature above 55°. It is used as an external application in cutaneous diseases, especially in veterinary practice.

Kohombe oil.—This is yielded by the seeds of *Melia azedarach*, (*Meliaceæ*,) a tree well known in the Southern States as the Pride of India. or China tree. It is a native of the East Indies, but has been carried to different regions of the globe. The Arabic name, azedarach, implies a poisonous plant. The oil obtained is semi-fluid and of a pale yellow color, and has been supposed to be useful in cases of consumption. The root is bitter, and is a well known anthelmintic.

Taipoo oil is obtained from the fruit of *Melia azadirachta*, closely allied to the preceding. It is much used by native Indian practitioners of medicine, and under the name of bitter oil is sold for burning.

Madia sativa, (*Compositæ Heliantheæ*,) an annual plant from Chili, where it has long been cultivated for the oil obtained from the ripened seeds, which is used instead of olive oil. It has been introduced and cultivated both in France and Germany, and has attracted much notice on account of the great percentage of oil contained in the seeds, being fully equal to that of the rape seed. It does not readily congeal, which makes it valuable for lubricating machinery. It is easily cultivated, requiring management similar to seed clover, but, owing to the glutinous nature of the stems and stalks, the seeds require to be thrashed out soon after the crop is cut, otherwise fermentation would injure them.

Tamanu oil.—This is yielded by the seeds of *Calopyhllum inophyllum*, (*Clusiaceæ*,) an East Indian tree, growing to a height of 80 to 100 feet. This oil is thick, of a dark green color, and strongly scented. It is used for burning, and has great reputation as a liniment for pains of the joints and bruises. Tamanu resin is obtained from crevices in the bark of this tree. It is a green heavy resin, which subsequently becomes dry, brittle, and aromatic.

Ben oil is procured from the seeds of *Moringa pterygosperma*, (*Moringaceæ*,) a small tree, seldom reaching over 20 feet in height, a native of Northern Africa. The oil is remarkably clear and limpid, has no perceptible smell, and is highly valued by watch-makers, who consider it one of the very best oils for delicate machinery. It is also sought after by perfumers, but is seldom found in commerce. The tree grows in Jamaica. The roots are pungent, resembling horse-radish in taste; hence its local name of horse-radish tree.

Yamadou oil is obtained from the seeds of *Virola sebifera*, (*Myristicaceæ*,) a tree growing 50 to 60 feet high in Guiana, North Brazil, and as far north as Panama, where it is called *Malaqueto de montana*. The seeds are macerated in hot water, and a heavy fatty oil is yielded, which is used for candles. An acrid red juice exudes from wounds in the bark, which is used medicinally.

Ram-til oil.—This is expressed from the seeds of *Guizotia oleifera*, (*Compositæ*,) an annual plant, native of Abyssinia, but cultivated in the East Indies for its oil. It is grown like a wheat crop. The oil is bland and sweet, and often used as a condiment, although its principal value lies in its adaptability as good lamp-oil. Seeds yield about 34 per cent. of oil.

Patchouli, *Pogostemon patchouli*, (*Labiatæ*,) is a small, shrubby herb, a native of Penang and Malacca. The leaves and young tops yield a volatile oil by distillation, which affords the patchouli, a peculiar perfume, highly prized by some people, while to others the odor is very disagreeable. Ill effects, such as nervous attacks and loss of appetite, have been ascribed to the constant and excessive use of this perfume.

Serpolet.—This is a species of camphor oil, distilled from the leaves and shoots of the wild thyme, *Thymus serpyllum*, (*Labiatæ*.) It is used in perfumery, and in Spain as an aromatic ingredient in olive pickles.

African palm oil.—*Elais Guineensis*, the celebrated African oil palm, is a native of Western Africa, where it reaches to a height of 25 to 35 feet. The fruit is borne in dense heads, measuring 18 inches to 2 feet in length, and 2 to 3 feet in circumference. The fruit is about 1½ inches long and 1 inch in diameter. The part yielding the oil is the outer fleshy coating of the fruit, but the seed, which is inclosed in a hard shell, also affords a fine oil. The common oil is of a buttery consistence of an orange-yellow color, and has a very strong penetrating smell. That from the kernels has a pleasant odor, when fresh. The oil is obtained by boiling the fleshy pericarp of the seeds, and skimming off the

oil as it comes to the surface. It is used by the natives as a butter, but its greatest use is in the manufacture of candles and soap.

Camphor oil is furnished by *Dryobalanops Camphora*, (*Dipteraceæ*,) a lofty-growing tree of the island of Sumatra. The wood is tough and durable, and is used for ship-building, its strong oil-scent saving it from the attacks of ship-worms. The oil is obtained by incision, and flows as a pale yellow liquid, called the liquid camphor of Borneo and Sumatra. It consists of resin and a volatile oil, having a camphorated odor, and has been used in scenting soap and other perfumes. Solid camphor is also found in the wood, especially in old trees. It differs from ordinary camphor by its greater hardness and brittleness. It is much prized by the Chinese, who ascribe many virtues to it.

Almond oil is yielded by the seeds of *Amygdalus communis*, (*Rosaceæ*,) a low-growing tree, native of Barbary and Morocco, but now distributed over almost all temperate regions, and growing spontaneously in many countries. This tree was cultivated in Palestine during the earliest historical ages. The oil is extracted by pressure of the fruit, previously pounded into a paste. It is more fluid than olive oil, of a clear transparent color, sweet to the taste, and has an agreeable smell. It is employed in soap-making, and is much used as a flavoring ingredient in cookery. It contains prussic acid, and requires to be used with caution, and in a diluted state. What is known as the essence of almonds is this oil in a diluted form.

Cashew-nut oil.—The cashew-nuts are produced by the *Anacardium occidentale*, (*Anacardiaceæ*,) a large tree growing both in the East and West Indies. The fruit in its natural state is very acrid and caustic, but when roasted affords an agreeable and wholesome article of food. The process of roasting requires care, the acridity of the fumes producing inflammation in the face when one approaches too near. The oil from the kernels is light yellow in color, of sweet taste, and is considered by many to be fully equal to the olive or almond as an edible oil. Sometimes these seeds are erroneously called cassia seeds. The stem of the tree furnishes a milky juice, which when dry becomes hard and black, and is used as a varnish. A gum is also found secreted by this plant, and is similar to gum arabic.

Ground-nut oil.—The earth-nut, more familiarly pea-nut, *Arachis hypogæa*, (*Leguminosæ*,) is well known, and extensively cultivated and used in this country. The plant is a native of Africa, but is now found in warm climates everywhere. Owing to the peculiarity of this plant to thrust its fruit into the soil to effect maturation, a sandy or very loose loamy soil is necessary for its culture. The nuts are valuable as an article of food, and are much used in various tropical countries; but the greatest value of this fruit is in the oil which it contains. This is good for every purpose for which olive or almond oil is used, and is very frequently substituted for the former, and very largely used in its stead. In many parts of India it is sold for pure olive oil, and for all alimentary purposes it is quite as good. As an illuminator it gives a superior light, and is of greater durability than that of the olive; but its light is feeble compared with that of the best burning oils. It is said to keep a long time without becoming rancid. Under favorable circumstances of ripening, the nuts will produce a large proportion of oil under ordinary extraction, but if heated before pressure, the quantity will be increased, but of an inferior quality. In its more northern range it yields less oil. The trade both in the nuts and in the oil is very large, and is extensively distributed over the globe. In South Carolina the nuts,

PLATE III.

OIL PLANTS.

Fig. 1. Olive. Fig. 2. Rape. Fig. 3. Peanut. Fig. 4. Castor Oil.

being roasted and ground, are used as chocolate, and are said to make an excellent substitute for that beverage.

Clove oil, or oil of cloves, is obtained from the flower-buds of *Caryophyllus aromaticus*, (*Myrtaceæ*.) It is associated with resinous, gummy, and astringent matter. The buds yield 17 to 22 per cent. of oil, which is aromatic and acrid, and has been used as a condiment and stimulant carminative. It is also employed by distillers and manufacturers of soap. An oil called clove oil is distilled from the leaves of the cinnamon, which is said to be equal in aromatic pungency to that made from the clove.

Cassia oil is obtained from the bark of *Cinnamomum cassia*, (*Lauraceæ*,) a tree of medium size cultivated in China, where the best oil is prepared. It is a yellow volatile oil, having much of the same properties as cinnamon, for which it is often substituted.

Cinnamon oil is obtained from the bark of the cinnamon tree, *Cinnamomum Zeylanicum*, much cultivated in Ceylon, Cochin China, and other places in the East and the West Indies. The fragments which remain after peeling, sorting, and packing the marketable bark, are roughly powdered and macerated in salt water for several days, and then distilled. The oil is at first of a yellow color, but soon assumes a reddish-brown hue. It has an odor intermediate between that of cinnamon and vanilla, but possesses in a high degree both the sweet, burning taste, and the agreeable aromatic smell of cinnamon. Eighty pounds of fresh, newly prepared bark yield about 2½ ounces of oil, which floats upon the water, and 5½ ounces of heavy oil, which is precipitated to the bottom of the receiver.

Galem oil, or shea butter, of Africa, is produced from the seeds of *Bassia Parkii*, (*Sapotaceæ*,) a medium-sized tree growing abundantly on the banks of the river Niger. The fruit when ripe is as large as the egg of the guinea hen, of oval shape, and covered with a pale green pellicle, beneath which is a farinaceous pulp of an agreeable flavor. The fruit, after having been dried in the sun, is pounded in a mortar until reduced to flour. It is then mixed with water, and boiled slowly for a short time, when the greasy particles become detached and are collected on the surface. When cold it thickens to the consistency of butter, and will keep fresh for two years. It is used for food; also for anointing sores and relieving pains, and for burning in lamps. It is an article of considerable trade with the natives of Western Africa.

Epic, or *Mowha oil*, is expressed from the seeds of *Bassia latifolia*, or Mahwah tree of Bengal. It is of a greenish-white color, and of the consistency of butter in a temperature below 70°, and is used for illumination, the manufacture of soap, and for various culinary purposes. A spirit resembling whisky is distilled from the flowers, and consumed in great quantities by the natives.

Phulwara, or *Pheolwa oil*, is produced from the seed-kernels of *Bassia butyracea*, or butter tree of Nepaul. The kernels are placed in a bag and pressed. The oil or fat, which is of a white color, immediately hardens. It is used as a soap and for burning in lamps; is soluble in warm alcohol, and is completely melted at a temperature of 120°.

Illepe oil is a product of *Bassia longifolia*, and is used by the inhabitants of Ceylon for burning and for cooking. It is also much used for anointing the skin, and is admirably adapted to removing the unctuosities caused by excessive perspiration, and for keeping the skin soft, pliable, and glossy, which is so conducive to health in tropical climates. The oil is white, and fuses at 80°.

Cohune oil is obtained from the nut of *Attalea Cohune*, (*Palmaceæ*,) a

Honduras palm. The nuts are about the size of the egg of the common hen, and grow in bunches containing six hundred to eight hundred seeds. The kernel tastes somewhat similar to the cocoa-nut, but is far more oleaginous, and the oil extracted from it is superior. It congeals at a temperature of 72°. It has been used for making composition candles, and is highly esteemed for that and other purposes.

Nahor oil is obtained from the seeds of *Mesua ferrea*, (*Guttiferæ*,) the iron-wood of tropical Asia. The oil is used as a lamp oil, and as a healing application to sores. The flowers of this plant are highly fragrant, and form an article of trade in East India bazars.

Kekune oil is pressed from the seed-kernels of *Aleurites triloba*, (*Euphorbiaceæ*,) the candle-nut tree of the Polynesian Islands. The kernels, when dried and stuck on a rod, are used by the inhabitants as a substitute for candles. They are also used as an article of food, and resemble walnuts in taste. When pressed, they yield a large proportion of pure, palatable oil, which is used as a drying oil for paints, and is known as country walnut oil. It is also used in the Sandwich Islands as a mordant for their vegetable dyes. The root of the tree affords a brown dye.

Castor oil.—This well-known oil is expressed from the seeds of the *Ricinus communis*, (*Euphorbiaceæ*,) a native of India, but now widely distributed and cultivated in various parts of the world, but nowhere more successfully than in this country. There are many varieties in cultivation, chiefly as ornamental plants, on account of the size and beauty of their foliage. Many of these have also very large seeds, but for medicinal purposes the small seeds of the species and of some dwarf varieties are considered to yield the best oil, although for course oils for burning, for lubricating machinery, and for use in veterinary practice, the larger seeds are more profitable. The uses to which this oil is applied are constantly increasing, and its consumption is very great. In tropical countries the *Ricinus* grows to a tree-like size, while in temperate climates it is an annual.

Bay or laurel oil.—The classical plant, the bay, the branches of which formed the crowns placed upon the heads of ancient heroes, is the *Laurus nobilis*, (*Lauraceæ*,) an evergreen tree, native of the south of Europe. The leaves have an agreeable aromatic fragrance, and are used by cooks and confectioners. Imported figs are usually packed with the leaves. From the fruit a butter-like substance is expressed, known in commerce as oil of bays, which has been used as an external stimulant, and in veterinary medicine.

Olive oil.—The olive tree, *Olea Europæa*, (*Oleaceæ*,) is among the oldest of cultivated plants, so old that its native country is not definitely known, the prevailing opinion being that it is indigenous to both Asia and Europe. The olive tree seldom exceeds 20 feet in height, is of a spreading habit, and very long lived. There are several well-marked varieties, each having its individual peculiarities similar to the differences of varieties to be found in apple and pear orchards. Olive oil is obtained by pressing the fruit, for which purpose it is passed through a mill with crushing stones, arranged so as to bruise the flesh without breaking the kernel. The pulp is placed in bags made of rushes, and by means of a gentle pressure the best or virgin oil is obtained. This is frequently still further purified by being filtered through cotton. A second and afterward a third quality are run off, the first by moistening the residuum with boiling water, and then crushing the stones, boiling the mass, and pressing it again. When the fruit is not sufficiently ripe, the fresh oil has a bitterish taste, and when too ripe it is fatty.

The most valued olive oil is that known as Provence oil. This is virgin oil, expressed with great care from ripe fruit immediately after being gathered, and before the slightest fermentation has taken place. It is usually exported in bottles surrounded by a species of rush net-work, and is used as salad oil. Gallipoli oil is produced most largely, and is sent out in casks, while the kind known as Lucca oil is put up in jars holding nineteen gallons each. The manufacture of olive oil is a very old practice, but it has undergone very considerable improvement of late years. By the introduction of hydraulic presses, the expressing of the oil is now much more rapid and effectual, and the injurious consequences of incipient fermentation, or those attending the heating of the pulp, are thus avoided.

Olives intended for preservation are gathered before they are ripe, and deprived of some of their bitterness by soaking for eight or ten hours in a lye composed of one part of quick-lime to six parts of wood-ashes, in water. They are then bottled in a brine of common salt and water, to which is usually added some aromatic flavor. The olive has been frequently introduced into the Southern States. The tree lives and grows healthily in South Carolina, and its culture might be prosecuted with advantage in many portions of the country. It has long been grown in California and Mexico.

Dill oil.—This is yielded by *Anethum graveolens*, (*Umbelliferæ.*) a native of the south of Europe and Egypt. It is cultivated in herb gardens for its fruit, which, when distilled with water, furnishes an oil that contains the principle upon which the carminative effects of the plant depend. It is generally used as dill water, to relieve flatulence and prevent the griping properties of some purgative medicines. The plant and the fruit are used as condiments by eastern nations. It is supposed to be the plant which is called anise in the New Testament.

Allspice oil.—This aromatic oil is distilled from the berries of *Eugenia pimenta*, (*Myrtaceæ*,) a medium-sized tree cultivated in the West Indies.

Anise oil is distilled from the fruit of the *Pimpinella anisum*, (*Umbelliferæ.*) but the true anise-seed oil is seldom found pure, being substituted by the oil from the fruit of *Illicium anisatum*, (*Magnoliaceæ*,) a large-growing shrub found in China, the fruit of which forms a considerable article of commerce among Asiatic nations.

Bacaba oil is obtained from *Œnocarpus Bacaba*, (*Palmaceæ.*) an Amazonian plant of lofty stature. It yields a colorless, sweet-tasted oil used in adulterating olive oil, and is excellent either for culinary or burning purposes.

Peppermint oil is distilled from the leaves of *Mentha piperita*, (*Labiatæ*,) a common cultivated hardy herbaceous plant. The oil and preparations made from it are largely used as aromatics, carminatives, and stimulants; and are especially useful in the alleviation of nausea, griping pains, and flatulence. Owing to its powerful taste, it is frequently used to conceal the taste of nauseous medicines.

Cardamon oil.—A volatile aromatic oil, distilled from the seeds of *Elettaria cardamomum*, (*Zingiberaceæ.*) It has been used in medicine.

Brazil nut or Castanha oil, is a bland oil, obtained by pressure from the seeds of *Bertholletia excelsa*, (*Lecythidaceæ*,) and used by watchmakers and artists. These nuts are sold in the shops as cream-nuts.

Cheroonjee oil is expressed from the seeds of *Buchanania latifolia*, (*Anacardiaceæ.*) an Indian tree. The seeds are eaten as almonds, and the fruits supply a black varnish.

Fennel oil is furnished by *Fœniculum vulgare*, (*Umbelliferæ*,) the common

fennel, a native of Europe, where it is grown for its fruit, from which is produced an aromatic oil, which also has carminative properties.

Jatropha oil is obtained from the seeds of *Curcas purgans* (*Euphorbiaceæ*.) or physic nut, a tropical tree found on the Philippine Islands, where the seeds are collected for the purpose of expressing the oil which they contain. The oil is said to be sometimes boiled with oxide of iron and used by the Chinese as a varnish. It is of a light color, and has been used as a substitute for linseed oil, as well as for burning in lamps, and for other purposes. Its qualities differ but little from those of castor oil, according to medical authorities, and twelve to fifteen drops are equal to an ounce of castor oil.

Lavender oil is produced by *Lavendula vera*. (*Labiatæ*,) a small shrub from the south of Europe, which is cultivated for the sake of its agreeable perfume. The essential oil is procured by distillation from the flowers. When dissolved in spirits of wine, and mixed with other perfumes, it forms lavender water. The red lavender drops of druggists consist of a spiritous solution of the oils of lavender and rosemary, mixed with certain aromatic and coloring materials. They are frequently used as a stimulant and cordial in cases of hysteria or faintness. Another species, *L. spica*, yields oil of spike, which is of a darker color and of a less agreeable perfume than the true oil of lavender. The oil procured from this plant is used by painters on porcelain, and by artists in the preparation of varnishes.

Simbolce oil is extracted from the seeds of *Bergera Konigi*, (*Aurantiaceæ*.) a small tree known in India as the curry-leaf tree, being used by the natives to flavor their curries with its aromatic fragrant leaves. The oil is used medicinally.

Linseed oil.—This well known oil is pressed from the seeds of *Linum usitatissimum*, (*Linaceæ*,) the valuable flax plant that has been cultivated from time immemorial. The first quality of oil is produced by simple pressure of the seeds, and is termed *cold drawn*; but the ordinary oil is obtained by breaking up, beating, and repressing the cake left after the first process. It is a non-drying oil, but by boiling with sugar of lead, red lead, or white vitriol, it is converted into a drying oil fit for the use of painters, who use it in large quantities. The seeds contain a mucilage which, dissolved in water, is demulcent and emollient.

Marking oil.—This is obtained from the pericarps or shell of the fruit of *Semicarpus anacardium*, (*Anacardiaceæ*,) an Indian tree termed the marking-nut tree. The hard shell of the fruit yields an oily juice, which, when mixed with lime, leaves an indelible mark on cloth. The seeds are used as an article of food, and are known as Malacca beans. From the seeds an oil is expressed which is used by printers, and when dry forms a black varnish used in the arts.

Sunflower oil, *Helianthus annuus*, (*Compositæ*.)—This well-known flowering plant is in some places very extensively cultivated for the oil contained in its seeds. The oil is palatable, clear, and flavorless; and when properly purified is used for the purpose of salad oil, or its adulteration. In Tartary the larger seeds are boiled and eaten, and in many districts they are used for fattening poultry, a purpose to which they are well adapted.

Poppy-seed oil.—The opium poppy, *Papaver somniferum*, (*Papaveraceæ*,) is an annual plant originally from the Levant, but now cultivated in different portions of the globe. The ripe seeds yield by expression over 50 per cent. of oil, which is bland and said to be used in adulterating olive oil. It is used by painters, and dries readily. It is much used in

opium-producing regions, both as an article of diet and for illuminating purposes. The oil is destitute of narcotic properties.

Thistle-seed oil.—This is a common name to an oil expressed from the seeds of *Argemone Mexicana*, (*Papaveraceæ*,) a native of Mexico, but now widely distributed over the globe. This oil is of a pale yellow color, clear, and mild. In South America it is much used by painters, and is said to give a fine shining appearance to painted wood. It is used medicinally as a substitute for castor oil, and the yellow juice of the stem is recommended in ophthalmia.

Oil of rhodium.—This strong-scented oil is obtained from the stems of *Rhodorrhiza scoparia*, (*Convolvulaceæ*,) a native of the Canary Islands. It is used to adulterate ottar of roses; also medicinally as an ointment.

Mace oil is obtained by pressure from the aril of the nutmeg. *Myristica moschata*, also a volatile oil by distillation of the fruit. The former is sometimes known as butter mace.

Oil of cubebs.—This medicinal oil is obtained from the fruit of *Cubeba officinalis*, (*Piperaceæ*,) a tropical plant having a shrubby, climbing habit of growth. The fruit has a general resemblance to black pepper, and when fresh contains about 10 per cent. of essential oil.

Mustard oil.—This is obtained from various species of *Sinapis*, and is pressed from the residuum consequent upon the preparation of powdered mustard. The siftings are mixed with water, which combines with other ingredients in the seeds, and a volatile oil is obtained. A fixed oil is obtained from the simple pressure of the residuum, which has no acridity, and has been used as a purgative and vermifuge. The volatile oil is very acrid, and has been employed as a rubefacient.

Rapeseed oil, Colza oil.—This is expressed from the seeds of *Brassica napus*, (*Cruciferæ*) and other species of *Brassica*, natives of Europe, where they are extensively cultivated for their oil products. The plants are cultivated in the manner usually adopted in the production of turnips or cabbages. The seeds are perfected the second year of growth. The oil is extensively used for machinery and for burning in light-house lamps. The refuse cake is a well known cattle food.

Gold of Pleasure oil.—This oil is obtained from the *Camelina sativa*, (*Cruciferæ*,) an annual, native of Europe, and cultivated to some extent for the clear yellow-colored oil obtained from its seeds. It much resembles linseed oil. The stems of the plant contain a considerable proportion of fiber, which is sometimes used in the manufacture of brooms.

Bergamot oil.—This volatile oil is obtained from the fruit of *Citrus bergamia*, (*Aurantiaceæ*.) Citron oil is also a product of this family, being an essential oil obtained from the *Citrus medica*, employed in perfumery and confectionery.

GUMS AND RESINS.

Benzoin or Gum Benjamin.—This is collected from the stem of *Styrax benzoin* (*Styracaceæ*), a native of Borneo and other Indian islands. Incisions are made in the bark, from which the juice exudes. When dried it is removed by a chisel or blunt knife. The gum which exudes from the natural fissures is considered the most valuable, having a stronger perfume than that produced from wounds in the tree. It is used medicinally by perfume manufacturers, and as a compound in the mixtures used as incense.

Storax is obtained from *Styrax officinale*, a native of the Levant. This balsamic resinous substance is obtained by pressure from strips of green bark. The result is liquid storax. Solid storax is supposed to be the

liquid mixed with fine saw-dust, and dried. It is used in perfumery, and medicinally as a stimulating expectorant.

Gamboge.—This gum resin is yielded by several plants. That known as Ceylon gamboge is obtained from *Garcinia morella*, (*Clusiaceæ*,) a fine tree with glossy foliage, somewhat like that of the evergreen magnolia. This plant is supposed to be a native of Siam. The gum is obtained by making incisions in the bark, or by breaking the branches, and collecting the juice as it drops. Gamboge is known in commerce in three distinct forms: in rolls or solid cylinders, in pipes or hollow cylinders, and in cakes. The former two are collected in the same manner, the juice when in a liquid state being run into hollow bamboos, and allowed to harden. In this form it is known as pipe gamboge. The cake or lump gamboge occurs in round or square lumps or masses several pounds in weight. It is used as a pigment in the arts, and medicinally as a purgative. *Garcinia pictoria* of Mysore yields a gum having the color and properties of gamboge. American gamboge is obtained from *Vismia Guianensis*, (*Hypericaceæ*,) a shrubby plant found in Surinam and Mexico, which abounds in a yellow resinous juice resembling, in its appearance as well as in its purgative and other properties, the gamboge of Ceylon. Other species found in Brazil and Guiana produce similar resins.

Tacamahaca resin is obtained from the stem of the cedar wood of Guiana, *Icica altissima*, (*Amyridaceæ*,) a very tall tree, yielding a durable fragrant timber, which is used for inside fittings of houses, especially book cases, the odor of the wood preventing injury from insects. The balsam or resin is used as a perfume. It remains in a semi-fluid state for some time, but ultimately becomes hard, and is used for burning as incense in churches. The branches of *Icica heptaphylla* are used as torches under the name of incense wood. Balsam of Acouchi, yielded by *I. heterophylla*, is used in medicine.

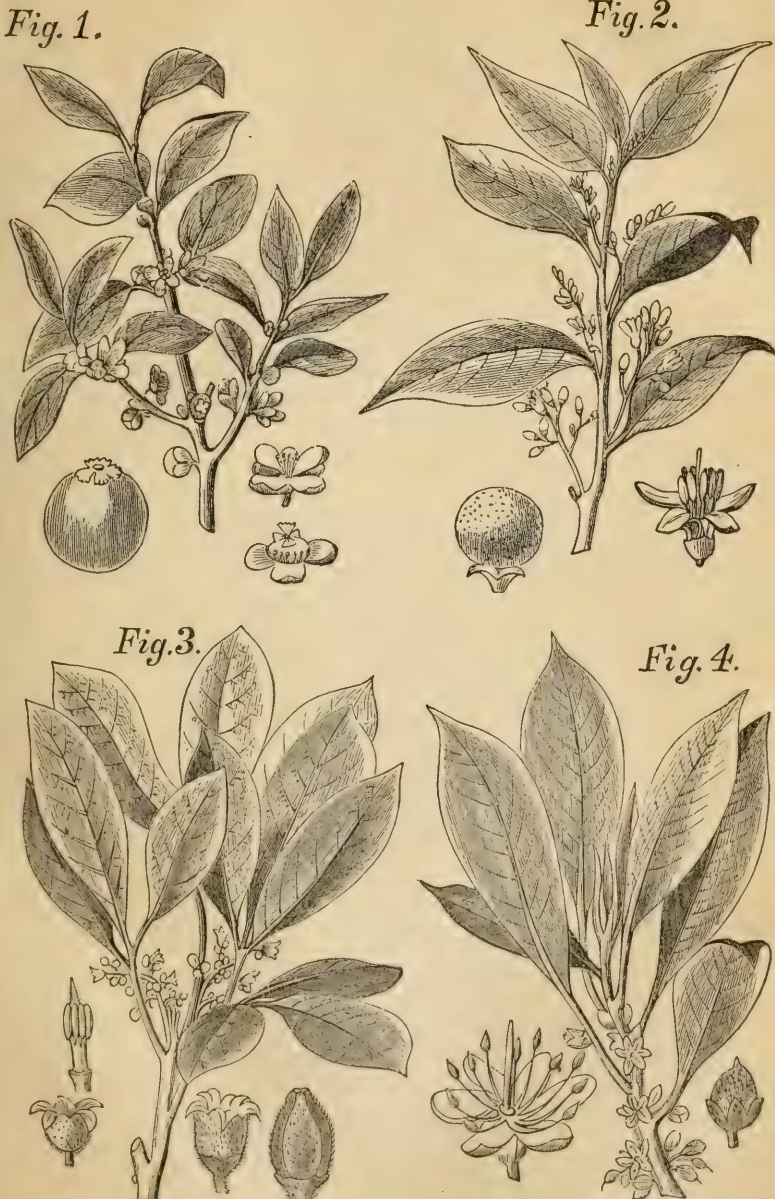
Tragacanth.—This gum-like substance is produced by *Astragalus gummifera*, (*Leguminosæ*,) a native of Persia and Asia Minor. The gum exudes naturally from the bark in the same way that gum exudes from the bark of plum or cherry trees. The hygrometric properties of the bark being very great, considerable moisture is absorbed by it during the night, which causes it to swell and crack, and from the openings thus formed the gum exudes. *Astragalus bœticus* is cultivated in some parts of Germany for the seeds, which are used as a substitute for coffee.

Kauri resin is a product of *Dammara Australis*, (*Coniferæ*,) a New Zealand tree reaching 150 to 200 feet in height. The resin is hard and brittle, like copal. It exudes chiefly from the lower portions of the trunk, either from natural fissures or wounds purposely made with an ax. It is at first about the color and consistency of cream, highly glutinous, and flavored like turpentine, but gradually hardens by exposure to the air, and changes to a dark color. The best resin is found by digging in the ground where old forests have been destroyed, and it is found from a few inches to as many feet in depth, and in localities now entirely denuded of trees. It is also found in the soil at the base of living trees. It is insoluble in water, and ornaments are carved out of the lighter amber-colored lumps. It becomes plastic at a heat of 180°, and can be molded into any form.

Dammar resin is the produce of *Dammara orientalis*, the Amboyna pine, a native of the Moluccas.

Grass gum or *Acaroid resin.*—This substance is produced by several species of *Xanthorrhœa*, (*Liliaceæ*,) natives of Australia, where they form characteristic features of vegetation. They form thick trunks like palms.

PLATE IV.



GUM PLANTS.

Fig. 1. Gamboge. Fig. 2. Benzoin. Fig. 3. Caoutchouc. Fig. 4. Gutta Percha.

The leaves are long, wiry, and grass-like, and are borne in a dense tuft at the top of the stem, and hang down gracefully all around. The long flower stalks rise out of the center sometimes as high as 20 feet, bearing at the top a dense cylindrical flower spike. The resinous product has long been known among druggists as gum acroides, and is used by the natives as a medicine in cases of diarrhœa. As seen in commerce it is very brittle, usually in small pieces, and in a state of coarse powder. Its color is deep yellow, considerably resembling gamboge, but darker; the powder is greenish yellow. The plant is composed of a core of hard fibrous pith about half of its whole diameter, around which there is a layer of resin varying from half an inch to one inch or more in thickness, which forms the connection between the leaves and the core. Between these leaves, and also adhering to and covering them, is a quantity of resin which exudes in large lumps from the sides of the plant. An average-sized plant will produce forty pounds.

Asafœtida.—This resinous gum is procured from the juice of the *Narthex asafœtida*, (*Umbelliferæ*,) a tall-growing perennial, native of Persia. The roots grow to a large size, and are allowed four to six years' growth before they are considered in the best condition for yielding the drug. When ready for use the stem is severed close to the surface of the ground, and incisions are made on the top of the stump from which the juice exudes and hardens by exposure, and is collected in its concrete state. In medicine it is used as a stimulant in hysteria and for other purposes.

India copal, piney varnish, white dammar, or gumanine, a useful gum resin known in different localities by the preceding names, is procured from *Vateria Indica*, (*Dipterocarpaceæ*,) a native tree of the Malabar coast. The resin is procured by cutting a notch in the trunk of the tree, from which the juice exudes and hardens by exposure to the air. It is largely used as a varnish for carriages, pictures, &c. It is also used by the Portuguese as an incense, and ornaments are fashioned from it under the name of amber. A vegetable butter is obtained from this fruit, which is of solid consistence, beautifully white, and requires a higher temperature to melt it than animal tallow. Candles manufactured from it burn with a clear light, and produce an agreeable fragrance. It is prepared by cleaning the seeds, and then roasting and grinding them into a mass. Water is added and the whole is boiled until the fatty matter rises to the surface, when it is removed.

Jalap is furnished by the tubers of *Exogonium purga*, (*Convolvulaceæ*,) a climbing plant, native of Mexico. The tubers are roundish, of various sizes, and dark-colored. They owe their purgative properties to their resinous ingredients, and worm-eaten tubers are more valuable than those that are sound, as the insects eat the farinaceous and woody portions of the tuber, and leave the resin. Indian jalap is obtained from the roots of *Ipomœa turpethum*. The resin is more diluted than in the true jalap, and is destitute of any nauseous taste or smell.

Wild jalap.—A resinous extract from the roots of *Podophyllum peltatum*, (*Ranunculaceæ*,) a native plant of active medicinal properties.

Scammony.—The roots of *Convolvulus scammonia* when cut exude a gummy resin or milky juice, which soon concretes, and is known as scammony. The plant grows abundantly in Greece, but the gum is seldom to be found pure, being frequently mixed with chalk. It is generally imported from Aleppo.

Ammoniacum is obtained from *Dorema ammoniacum*, (*Umbelliferæ*.) This plant is a native of Persia, and abounds in a milky juice, which exudes upon the slightest puncture being made, and dries upon the stem

in small rounded lumps or tears. It is used as a stimulant expectorant. The ammoniacum of the ancients—a gum resin, like asafœtida—is supposed to be yielded by *Ferula tingitana;* and sagapenum, a similar drug, is supposed likewise to be the product of this genus.

Gambier, or *Terra Japonica*, is obtained from *Nauclea gambier*, (*Cinchonaceæ*,) a shrubby, climbing, Asiatic plant. Gambier is prepared by boiling the leaves and young shoots of the plant in water until the decoction thickens to the consistency of molasses. It is then run into narrow, oblong molds, where it remains to thicken; after which it is cut into small cubes or slices, and these are thoroughly hardened and dried in the sun. It is used by the Malays for mixing with the preparation of areca-nut and betel-leaf, which they are in the habit of chewing; and it is also used for tanning leather, and by dyers and curriers. There are several qualities of the gambier extract; the best is white, brittle, and has an earthy appearance when rubbed between the fingers. This earthy appearance gave it the name of terra japonica, which was then supposed to come from Japan. Gambier is one of the most powerful of the pure astringents.

Manna is a concrete saccharine substance, procured from *Ornus Europæa* and *Ornus rotundifolia*, (*Fraxineæ*,) natives of the south of Europe. They form trees about 20 feet in height, and are cultivated in plantations in Sicily for the manna they produce. The manna is obtained by making incisions in the stem and branches. The best article is collected from the young branches or upper part of the stem; it hardens on the stem, but is further dried after removal from the tree. Manna is used in medicine as a gentle tonic. It is white, inodorous, crystallizable in semi-transparent needles, and of a sweetish taste. Manna sugar, or mannite, differs from other sugars in not being fermentescible. In Styria the larch (*Larix Europæa*) exudes from its leaves and branches a honeyed juice, which, on becoming hard, is called manna or briancon. The cedar of Lebanon, *Abies cedrus*, (*Coniferæ*,) produces small quantities of transparent resinous drops, called manna by the monks, who collect it and prepare from it various ointments, which have considerable reputation in Syria as a remedy for phthisis.

The manna by which the Israelites were miraculously fed is supposed to be identical with an exudation found on the stems of *Alhagi maurorum*, (*Leguminosæ*,) a shrubby plant which covers immense plains in Arabia and Palestine. The juice hardens on the branches, and is most abundant during hot weather, and is collected by the Arabs who cross the deserts, they using it as nutriment for themselves and camels, the latter being very partial to it.

Tamarisk manna, or manna of Mount Sinai, is produced through the puncture of *Coccus manniparus*, an insect inhabiting the tamarisk trees, which grow abundantly in that vicinity. This saccharine secretion exudes as a thick, transparent sirup, and drops from the branches upon the ground, and, being collected and cleaned, is eaten with bread, and is considered a delicacy; it is also reputed as efficacious in diseases of the chest. Australian manna is produced by the *Eucalyptus mannifera*, (*Myrtaceæ*.) This manna contains a saccharine matter different from mannite, and nearly similar to glucose. It is much used as a pleasant purgative.

Red gum.—This is yielded by the *Eucalyptus rostrata*, a common tree in many parts of Australia. The gum exudes in a fluid state from the bark, and, by evaporation of the water by which it is held in solution, concretes into a beautiful ruby-colored gum. As a medicine it is a pow-

erful astringent, and is sometimes employed with great success in disorders in which astringents are indicated.

Aloes.—This bitter drug is the dried resinous juice derived from the leaves of several species of aloe, a genus of liliaceous plants, natives of temperate and sub-tropical climates. The best kind of aloes is the socotrine, the product of *Aloe Socotrina*, a native of the island of Socotra, in the Indian Ocean. Hepatic aloes, socalled from their liver-like color, are produced by *A. Arabica*. Barbadoes aloes are produced from *A. vulgaris*, a native of Cape Colony. It is more dusky in hue than the East Indian species, and more nauseous and bitter. Caballine or horse-aloes are the refuse of the Barbadoes, and from their rank, fetid smell, are useful only for veterinary medicine. Cape aloes are produced by *A. spicata* and *A. commelini;* are lighter in color than the other species, but possessed of a strong, disagreeable odor; the color is more like gamboge. The yellowish juice is stored up in greenish vessels lying beneath the skin of the leaf, and when the leaves are cut the juice exudes, and is gradually evaporated to a firm consistence. An inferior product is obtained by pressing the leaves, or by cutting them in pieces, boiling them, and evaporating the decoction to a proper solidity. The drug is used as a purgative, and in small doses as a tonic.

Balsam of Peru.—This drug is obtained from *Myrospermum Peruiferum*, (*Leguminosæ*,) a native of Peru and other parts of South America. The mode of procuring the balsam is by making incisions in the tree from which it gradually exudes, and is absorbed by pieces of cotton rags which are inserted for the purpose. During rainy seasons the supply is much lower, and the expedient of lighting a fire is resorted to, which causes the gum to exude more freely, but is followed by the destruction of the tree. When the rags are saturated they are thrown into boiling water, which separates the balsam. It is then collected and placed in suitable vessels for sale. It is a thickish liquid, with a fragrant aromatic smell and taste.

Balsam of Tolu.—This is yielded by *Myrospermum toluiferum*, and is a product of similar character to the preceding. It is at first soft, but becomes hard and brittle by exposure. It is used in chronic coughs, and for other medicinal purposes.

Gum butea.—This is the hardened juice of *Butea frondosa*, *(Fabaceæ,)* a tree that attains a medium height, and is very common in Bengal, and there known as the dak or tisso. From natural fissures, or wounds in the bark, there exudes, during the hot season, a beautiful red juice, which concretes into a ruby colored, brittle, astringent gum, analogous to gum kino, for which it has been employed under the name of dak gum. It soon loses its beautiful color upon exposure to the air, when it becomes darker colored than the ordinary kino of commerce. This gum, when held in the flame of a candle, swells and burns away slowly, without smell or flame. If placed in the mouth it soon dissolves, its taste being strongly astringent. It is used for tanning leather. A coarse fibrous material obtained from the bark is used as a substitute for oakum for calking seams of boats. The lac insect punctures the young twigs, and causes the formation of the substance known as stick lac, used in the manufacture of sealing wax, and also as a dye. The seeds yield a thick dark-colored oil called moodooga, which the native doctors consider to possess anthelmintic properties.

Mastic is obtained from *Pistacia lentiscus*, *(Anacardiaceæ.)* a small evergreen tree, native of Southern Europe, Northern Africa, and Western Asia. The resin is gathered from wounds made in the bark, from which it exudes in drops, and hardens into a semi-transparent gum. It

is principally produced in Asiatic Turkey, and is consumed in large quantities by the Turks for chewing, to sweeten the breath and strengthen the gums. It is also employed for varnishing, and occasionally in dentistry.

Cape mastic.—The resin bush of the Cape of Good Hope, *Euryops multifidus, (Compositæ,)* affords a gum from its stem and branches, of a yellowish, semi transparent appearance, which is gathered and used by the natives, but is sparingly introduced in commerce.

Labdanum.—This gum exudes from the leaves and branches of *Cistus Creticus, (Cistaceæ,)* a low-growing shrub, native of Crete. The gum emits a pleasant balsamic odor, and has been used as an expectorant.

Galbanum.—This balsamic gum resin is obtained from *Bubon galbanum, (Umbelliferæ,)* a native of the Cape of Good Hope. The name is also applied to the resin of *Opoidia galbanifera*, a Persian umbelliferous plant. The resin possesses similar properties, but inferior, to those of asafœtida. *Galbanum officinale*, of the same family, has been so named from a supposition of its yielding a resin or gum of this kind.

Sagapenum gum is produced by *Ferula Persica, (Umbelliferæ,)* a native of Persia, and at one time supposed to be the source of asafœtida. This is somewhat similar, but less powerful.

Elemi.—This resin is obtained from one or more species of *Amyris, (Amyridaceæ,)* a genus of Indian trees remarkable for their resinous products. Indian bdellium, or false myrrh, is obtained from *A. commiphora.* This is a gum resin, with properties similar to the myrrh, but not so valuable.

Anime.—The West India locust tree, *Hymenæa Courbaril, (Cæsalpiniæ,)* known in Panama as algarroba, is a tree of the largest size. The resin exudes from the trunk, and large lumps of it are found about the roots of old trees. It is so named from its resemblance to the valuable anime resin of Africa.

Gum Arabic is furnished by various species of *Acacia, (Mimoseæ,)* such as *Acacia verek, A. Arabica, A. vera, A. Adansonii*, and others, natives of Arabia, Barbary, and the East Indies. It is collected as it exudes from the plants in a liquid state. A short exposure to the sun, heat, and air, hardens it into a solid mass. It is used as food, in medicine, and largely in the arts and manufactures.

Gum kino is obtained from *Pterocarpus marsupium* of India, and *P. erinaceus* of Africa, a genus of *Leguminosæ.* These trees are of large size, and the gum is obtained by making incisions in the bark, from which the juice exudes, and hardens into a brittle mass, easily broken into little angular shining fragments of a bright ruby color. It is highly astringent, and is used medicinally in diarrhœa.

Gum guaiacum is obtained from *Guaiacum officinale, (Zygophyllaceæ,)* a West India tree that furnishes the heavy wood called lignum-vitæ. The resin exudes from the stem, and hardens on the bark; or holes are bored in logs of the wood which are placed on a fire, so that when the resin is melted it runs through the hole into vessels placed to receive it. Guaiacum is greenish-brown, with a balsamic fragrance, and is remarkable for the changes of color which it undergoes when brought into contact with various substances. Gluten gives it a brown tint; nitric acid and chlorine change it successively to green, blue, and brown. The resin, as well as the bark and wood, is used medicinally as a stimulant in chronic rheumatism and other complaints.

Clusia is a genus of *Clusiaceæ* or *Guttiferæ*, chiefly climbing plants and shrubs, a few attaining the size of trees, natives of tropical America. *C. insignis*, a Brazilian plant, exudes a considerable quantity of resin

from the disk and stamens of the flowers, which is used in medicine. *C. alba*, *C. rosea*, and *C. flava*, in the West Indies, yield an abundant tenacious resin from their stems, which is used for the same purposes as pitch. It is first of a green color, but when exposed to the air turns to a brown or reddish tint. *C. duca* yields a resin known in Columbia by the name of duca, which is burned for the sake of its pleasant odor.

Hog gum.—The hog-gum tree is *Moronobea coccinea*, (*Clusiaceæ*,) a lofty growing plant, reaching to 90 or 100 feet in height, a native of the West Indies and South America. A pellucid juice exudes from incisions in the bark, and after a brief exposure hardens into a yellow resin, resembling Burgundy pitch in appearance. In Jamaica, hogs when wounded rub the injured part against the tree, so as to smear themselves with the resin, which possesses vulnerary properties, and hence its common name. The resin has been employed medicinally as a substitute for balsam of copaiva, and pitch plasters have been made of it. In Guiana and Brazil, where it is termed mani, or oanani, the natives make torches with it, and use it to pitch boats.

Gum sandarac.—This resin is produced by *Callitris quadrivalis*, (*Coniferæ*,) a medium-sized evergreen tree, native of Barbary. It is used in varnishing, and when powdered finely and sifted, and mixed with the finely powdered calcareous bone of the cuttle-fish, forms the article of resinous powder known as pounce. The timber of this tree is very hard, fragrant, and durable.

Kuteera gum is obtained from the stem of *Cochlospermum gossypium*, a shrub or small tree found in the Indian peninsula. This gum is often used as a substitute for gum tragacanth. The seeds of the plant are covered with a cottony down, which is used for stuffing pillows and cushions. The gum of *Sterculia urens* (*Sterculiaceæ*) is also known as kuteera. This tree is a native of India; the gum resembles tragacanth both in external appearance and in its property of not dissolving in cold water, but merely swelling and becoming jelly-like, owing to the presence of bassorine.

Succory gum is obtained from *Chondrilla juncea*, a plant belonging to the lettuce family. It is a native of the south of Europe, and furnishes a narcotic gum in limited quantities.

Caranna resin is produced by *Bursera acuminata*, (*Amyridaceæ*,) a shrubby West India plant. The juice, which exudes from the bark when the tree is wounded, contains a kind of turpentine oil, which rapidly congeals on exposure. *Bursera gummifera* grows to a tree of large size on the island of San Domingo. A whitish, resinous matter flows copiously when the bark is pierced, which is much used in making flambeaux, and is also burned as incense in churches. The wood is used in making canoes.

Churrus.—This resin is produced by the hemp plant, *Cannabis sativa*, but only in very hot, dry climates. It is gathered by men clad in leathern dresses, running through the hemp-fields, and brushing through the plants rapidly. The resin adheres to the leather, and is subsequently scraped off and kneaded into balls. When used in small quantities it produces pleasant excitement, which passes into delirium and catalepsy if the quantity is increased; if still further continued, a peculiar form of insanity is produced. Many of the Asiatics are passionately addicted to this kind of intoxication.

Gum olibanum is obtained from *Boswellia serrata*, (*Amyridaceæ*,) a tree about 40 feet in height, a native of India. The resin is used as a pitch, but being hard and brittle, it is boiled with some low-priced oil to render it

workable. By some it has been supposed that this was the frankincense of the ancients.

African bdellium is a gum resin furnished by a small composite plant, *Ceradia furcata*, a native of the southwest coast of Africa. The gum exudes in small, pellucid tears of a pale yellow color, and somewhat hard and brittle. It has a slightly bitter and fragant resinous taste, possesses a very fine aromatic smell, and throws out a refreshing and agreeable perfume when burning. Lately it has been surmised that this plant was the true source of frankincense.

Myrrh.—This resinous perfume is produced by *Balsamodendron myrrha*, (*Amyridaceæ*,) a large-growing shrub, native of Arabia Felix. The milky juice of the tree is made to exude by wounding the bark, and it rapidly concretes into brittle, yellowish-red, semi-transparent tears, having a bitter, disagreeable, and acrid taste, with a strong and not particularly pleasant fragrance. It was formerly much valued for its property of resisting putrefaction, and at an early date formed one of the ingredients for embalming the dead. The ancients considered it a universal medicine. It is known as balm of Gilead, balm of Mecca, and opobalsamum.

Googul and *mukul* are names given in Scinde and Persia to a resin yielded by *Balsamodendron mukul*. This is considered identical with the bdellium of Dioscorides and the Scriptures. The tree is a native of Scinde, and the resin is collected by making incisions in the bark and permitting the gum to fall to the ground; hence it is full of impurities. It is used as a medicine in veterinary practice, and burned as an incense.

Bayee balsam is a product of *Balsamodendron pubescens*. This is brittle, tasteless, and inodorous, and it is presumed that it is frequently employed to mix with the more valuable products of this genus of gum-producing plants.

Wallaba gum is obtained from *Eperua falcata*, (*Leguminosæ*,) a large tree, abundant in the forests of Guiana. The gum of this tree is used as an application to wounds. The bark is bitter, and the natives use it in a decoction as an emetic. The wood of the tree is strongly impregnated with a resinous oil which renders it very durable when used for domestic purposes, such as for shingles, house-framing, &c.

Balsam of Maria is produced by a Peruvian tree named *Verticillaria*, a genus of *Clusiaceæ*. The tree yields an abundant supply of a balsamic resin, but its properties are not known to botanists.

Balsam of umire is furnished by *Humirium floribundum*, (*Humiriaceæ*,) a small Brazilian tree, which yields, from wounds in the bark, a yellow-colored fragrant balsam. The bark is highly esteemed as a perfume by the Brazilians. *Humirium balsamiferum*, the houmiri tree of French Guiana, yields a reddish balsamic juice, possessing an odor similar to that of storax, and which after a time becomes brittle and hard, in which state it is burned as an incense or perfume. Medicinally it is used as an anthelmintic, and an ointment preparation is employed for pains in the joints.

Melanorrhœa usitatissima, (*Anacardiaceæ*,) an East Indian tree which yields a highly useful and extensively employed varnish, obtained by a process of tapping or boring shallow holes in the trunk of the tree, in which are inserted hollow bamboo canes. After remaining one or two days these canes become filled with a whitish-colored thick juice, which turns black when exposed to the air, and can be preserved only by immersion in water. All kinds of domestic furniture and utensils are lacquered with this juice, which is laid on thinly and dried slowly,

when it turns to a beautiful dark color. Like other varnishes derived from the same natural order, it is very caustic and apt to cause erysipelatous swellings, if applied to the skin. The wood of this tree is excessively hard and heavy, and is called the lignum-vitæ of Pegu. Anchors for boats are made of it, and it is employed for all purposes where great strength and durability are required.

Dipterocarpus trinervis and *D. lævis* (*Dipterocarpeæ*) are East Indian trees that furnish thin liquid balsams used medicinally, for burning in torches, and for painting vessels of various kinds. The resinous fluid is collected by cutting a deep notch in the trunk of the tree near the ground, where a fire is kept until the wood is charred, when the liquid begins to ooze out. It is much used as a varnish for window-frames, doors, &c., and has been found a good substitute for balsam of copaiba, which it greatly resembles. By the application of heat it becomes concentrated and semi-solid. Mixed with dammar resin it has been found valuable in preserving timber from the attacks of insects and worms.

Shorea robusta, (*Dipteraceæ*,) a fine timber tree of the Himalaya mountains, furnishes a resin which is known as a variety of dammar, and is adapted to the same uses. An oil is likewise obtained from its seeds. The wood of this tree, as also that of *S. selanica*, is known as Saul-wood, which is close-grained, strong, and durable, and is employed for ship-building and engineering purposes, where great strength and toughness are requisite. It is considered stronger, as it is heavier, than the famous teak wood of India.

Opopanax gum is the milky juice of *Opopanax Chironium*, (*Umbelliferæ*,) a plant closely resembling the parsnip, native of the south of Europe. The milky juice dries into a gum resin, having properties very similar to those possessed by ammoniacum.

Mesquite gum.—This is yielded by *Prosopis glandulosa*, (*Mimoseæ*, *Leguminosæ*,) the mesquite tree of Texas. This gum closely resembles gum arabic, and, as the tree is allied to the true gum-producing family, it may be found worthy of attention for its gum.

Lign aloes.—The tree called calambac by the ancients, and which furnished the aloes alluded to in the Bible, where it is said "All thy garments smell of myrrh, aloes, and cassia," is supposed by some to have been the eaglewood, *Aloexylon Agallochum*, (*Leguminosæ*,) a lofty, upright-growing tree, native of the mountains of Cochin China and the Moluccas. It yields a perfume which is the most esteemed by Oriental nations. The oleaginous particles stagnate and concrete into resin in the inner part of the trunk and branches, by which the natural appearance of the wood is altered, becoming of a dark color, and acquiring a fragrant smell. At length the tree dies, and when split open the resinous part is removed. It contains little else than the camphoraceous matter, and receives the name of aloes from its bitter taste. The wood of this tree is very valuable. Some of the most precious jewels of East India manufacture are set in it, and it sells at the rate of $3,000 per ton. This tree is supposed to be the plant alluded to in the Scriptures, Numbers xxiv, 6: "As the valleys are they spread forth, as gardens by the rivers' side, as the trees of *lign-aloes* which the Lord hath planted, and as cedar trees beside the waters." Owing to the imperfect knowledge of botany possessed by the ancients, and the meager descriptions they have left, there has been a difficulty in accurately defining the tree which produces this fragrant substance; hence the aloe wood of India has also been mentioned as the source of this resinous perfume. This is the *Aquilaria Agallocha*, (*Aquilariaceæ*,) a broad-spreading tree, containing a highly odoriferous resin, and an essential oil which is also held in great esteem. The

Orientals burn it in their temples for its fragrance, and it has also been used in medicine.

Balsam of copaiba.—This drug is produced by *Copaifera officinalis*, (*Leguminosæ*,) a lofty tree, native of South America. The resinous juice is obtained by boring holes near the base of the tree, reaching into the pith or center of the stem, from which it flows copiously. The older trees afford the best quality of balsam, and yield it several times during the year. That taken from young trees is crude and watery, and of less value. At first the juice is fluid and without color, but soon acquires a consistency equal to that of thick oil, and changes to a yellowish color. An inferior article is obtained by decoction from the bark and branches, which is destitute of the qualities of the true balsam, and is thin and liquid. The pure balsam has rather an agreeable smell, and a bitter, biting taste of considerable duration in the mouth. It dissolves entirely in rectified spirit, especially with the addition of a little alkali, the solution having a very fragrant smell. Distilled with water it yields nearly half its weight of a limpid essential oil, and in strong heat, without addition, a blue oil.

Mexican elemi is a greenish resin furnished by *Elaphrium elemiferum*, (*Amyridaceæ.*)

Eastern elemi is furnished by *Canarium commune*, (*Amyridaceæ*,) a plant cultivated in the Moluccas for its fruit. A gum exudes from its bark, which is said to resemble in its properties the balsam of copaiba. Another species, *C. strictum*, is known in Malabar as the black dammar resin tree, in contradistinction to the white dammar, *Vateria Indica*.

Jarilla balsam is yielded by *Adesmia balsamifera*, (*Leguminosæ*,) a Chilian plant of great beauty when in blossom. This balsam has a pleasant odor, perceptible at a great distance, and is said to be of much value in healing wounds.

Putty root.—The plant bearing this name is *Aplectrum hyemale*, (*Orchidaceæ*,) a terrestrial orchid, a native of our woods, which forms small tubers containing a quantity of adhesive mucilage, which has been used in mending broken porcelain; hence its local name.

Caoutchouc, or India-rubber.—One of the plants that furnish this substance is *Siphonia Brasiliensis*, (*Euphorbiaceæ*,) a common tree in the forests of Para. This gum exists in the tree in the form of a thin, white milk, and is obtained by making incisions in the trunk, from which it exudes, and is collected in vessels, and afterward converted into the black, homogeneous, elastic mass, familiar to us as India-rubber, by pouring the milk upon molds, and immediately holding them over a dense smoke. As it solidifies another coating is poured over it, and the process is repeated until the required thickness is secured.

Siphonia elastica, *S. lutea*, and *S. brevifolia* also furnish India-rubber of good quality. Others of this genus yield an inferior, brittle gum.

Gutta percha.—This is the inspissated juice of *Isonandra gutta*, (*Sapotaceæ*,) a large forest tree, reaching a height of 60 to 70 feet, with a trunk 2 to 3 feet in diameter. It is a native of the islands of Southern India, especially Borneo and Sumatra. The raw gutta-percha is exported in lumps weighing five to six pounds. It is prepared for use by cutting it up in slices, which are softened by being immersed in hot water; they are then torn into fine shreds, by rapidly revolving cylinders set with sharp teeth, and thrown into cold water, when the impurities sink, and the gutta-percha floats on the surface; the shreds are then transferred to hot water, and are made into solid masses, which are afterward kneaded by machinery, in order to expel the extraneous moisture.

Balata gum.—This elastic gum is obtained from *Mimusops balata*,

(*Sapotaceæ.*) a native of British Guinea, where it forms a tree of large dimensions. The milky juice is procured by incision of the trunk. It dries very quickly on exposure to the air, if the atmosphere is dry, and it can be molded into shape by first being softened in water. This gum appears to be of a character intermediate between India-rubber and gutta-percha, possessing the elasticity of the one and the ductility of the other, without the intractability of India-rubber or the brittleness of gutta-percha. It has been successfully employed as an insulating medium for telegraphic purposes.

Urceola elastica, (*Apocynaceæ.*)—A large climbing shrub of the islands of Sumatra and Borneo, yielding a milky juice which forms a caoutchouc called juitawan, but owing to the want of proper care in its preparation, it is inferior in quality to that from South America, the milky juice being simply coagulated by mixing with salt water instead of being gradually inspissated in layers on a mold. It produces fruit about the size of an orange, containing numerous seeds surrounded by an eatable pulp, which is highly prized by the inhabitants.

Castilloa elastica, (*Atrocarpaceæ.*)—A Mexican tree that contains a milky juice which, under proper preparation, becomes solidified into caoutchouc.

Alstonia scholaris, (*Apocynaceæ*,) called pallmara or devil tree about Bombay, is a tree of large dimensions, with a furrowed, rough bark which is intensely bitter, and is used medicinally. It has been stated recently that the juice of this tree possesses the same properties and is as readily manufactured as gutta-percha. It softens quickly when plunged into boiling water, is soluble in chloroform and turpentine, and receives and retains even delicate impressions.

Mudar gum.—The mudar tree of Africa, *Caloptrohis gigantea*, (*Asclepiadaceæ*,) abounds in a milky juice which hardens into a substance closely resembling gutta-percha, and the root yields a substance named *mudarine*, which possesses the property of gelatinizing when heated, and returning to a fluid state when cool. These products are used medicinally.

Euphorbia cattimandoo, (*Euphorbieceæ.*)—This East India plant affords a juice which furnishes caoutchouc of a good quality, and is used for a variety of purposes. The milk is obtained by simply cutting the branches, when it flows freely. It is collected and boiled at once, and is then very elastic, but soon becomes resinous or brittle, in which state it forms a good cement by heating. This gum can be molded to any shape when first boiled, and after becoming hard it can be made soft and pliable by heating or soaking in warm water, and in that state will take any desired form. The gum resin known as euphorbium is a product of several species of euphorbia, from Africa, the milky juice being collected in leather bags. It is extremely acrid, and is used in external applications. Some authorities regard it as a poison.

The India-rubber of the East is yielded by various species of *Ficus*, particularly *Ficus elastica*, (*Moraceæ*,) which attains to a large size, and sends down roots similar to the famous banyan tree. The juice is collected and spread over molds in thin layers, and dried either by fire-heat or by the sun.

Vahea gummifera, (*Apocynaceæ.*)—A milky juice, obtained from this plant in Madagascar forms a superior article of caoutchouc.

Hancornia speciosa, (*Apocynaceæ.*)—This is a Brazilian fruit tree, called mangaba. It abounds in a viscid milky juice which, when collected and exposed to the air, hardens into a caoutchouc, and is one of the sources of that gum.

TEA, COFFEE, ETC.

The spreading, glossy, green-leaved, evergreen shrub, *Thea viridis*, *(Camelliaceæ.)* furnishes material for an immense traffic throughout the world. The native country of the tea plant is uncertain. Hitherto the only country in which it has been found in a really wild state is Upper Assam; but China, where the plant has been cultivated for many centuries, has not yet received so thorough an exploration by botanical travelers as to warrant the assertion that it is not indigenous to every section of that vast country. A Japanese tradition ascribes its introduction into China to an Indian Buddhist priest who visited that country in the sixth century, which would seem to favor the supposition of its being of Indian origin.

Although it has been introduced into many parts of the globe, it has been cultivated more extensively and for a longer period in China than in any other region. It is there successfully grown between the twenty-seventh and thirty-second degrees of north latitude, and in Japan as far north as the forty-second degree. It is also cultivated in the island of Bourbon, at St. Helena, and on a large scale in the island of Madeira, at an elevation of 3,000 feet above the level of the sea. It is successfully produced in Java, and flourishes on the Himalaya mountains. It has withstood the cool summers and winters of the climate of Britain, and endures the climate of this country as far north as the District of Columbia, where it has been growing for the past ten years, and can be grown over a vast extent of the United States, so far as climate is concerned; and as regards soil, it is well known that it will grow anywhere and on any soil that is capable of supporting currant or blackberry bushes.

The black and green teas of commerce are produced from this plant. The opinion was at one time quite prevalent that there existed several species of *Thea*, but it is now known that the different sorts in market are indebted to artificial manipulations for much of their apparent variety and distinctive qualities. Many of the names attached to teas are merely descriptive of the locality or country where they are produced, the condition of the leaves when gathered, and the mode of preparing them for market. Thus there is Java tea, Japan tea, and Assam tea; bohea tea, from coarse leaves; gunpowder tea, made from the small, close-curled young leaves; and green tea, colored to suit its name. In the preparation of black tea, the freshly gathered leaves, being partially dried by brief exposure in the open air, are thrown into round, flat iron pans, and exposed to a gentle fire heat for five minutes, which renders them soft and pliant, and causes them to give off a large quantity of moisture. They are then emptied into sieves, and while hot they are repeatedly squeezed and rolled in the hands to give them their twist or curl. They are next placed in the open air, in the shade, for a few days, and finally they are completely dried in iron pans over a slow fire. Green tea, when genuine, is prepared in a similar manner, except that it is dried with more care, and by a slower process, but the greater part of the green tea consumed in Europe and America is colored by the Chinese to suit the demands of foreign trade.

There are about a dozen varieties of tea in commerce, but, besides the preceding distinction of color, they consist merely of different sizes obtained by sifting. The active principles in tea are theine and a volatile oil, to the latter of which its flavor and odor are due, and which possesses narcotic and intoxicating properties. It also contains 15 per cent. of gluten or nutritious matter, and more than 25 per cent. of tan-

PLATE V.

BEVERAGE PLANTS.

Fig. 1. Coffee. Fig. 2. Tea. Fig. 3. Chocolate. Fig. 4. Maté.

nin. Physiologists are not thoroughly agreed as to the effects of tea upon the human system. A recent medical opinion maintains that the use of tea increases the assimilation of food, both of the flesh-forming and heat-forming kinds, and that with abundance of food it must promote nutrition, while in the absence of sufficient food it increases the waste of the body.

Paraguay tea, or *Yerba de mate*, *Ilex Paraguayensis*, *(Aquifoliaceæ.)*—The leaves of this South American tree are used in furnishing the beverage, yerba mate. They yield the same active bitter principle called theine which is found in the leaf of the Chinese tea plant, and form a commercial product that occupies the same important position in the domestic economy of South America as the famed China plant does in this country, and is consumed to the extent of several thousand tons annually. The leaves are prepared by drying and roasting, not in the fashion of making Chinese teas, but by cutting large branches from the trees, which are placed on hurdles over wood fires, and kept there until the leaves are sufficiently roasted, when they are removed and placed on a hard floor, and the dried leaves knocked off by beating the branches with sticks. The leaves are then gathered up, reduced to powder in wooden mills, and packed for market. This tea is often packed in sacks made of raw hides, which are sewed together in a square form. The powdered leaves are pressed into the sacks with great force, and when full they are sewed up and exposed to the sun, where the hide dries and tightens over the contents, forming a package nearly as hard and heavy as stone.

There are several grades or sorts of mate tea in the South American markets, valued according to the age of the leaf and the modes of preparation. It is prepared for use by placing a small quantity of the powder in a cup, and pouring boiling water over it; the decoction is quaffed or sucked through a *bombilla*, or tube having a bulb perforated with minute holes. It has an agreeable, slightly aromatic odor, rather bitter to the taste, but very refreshing and restorative to the body after undergoing great fatigue. It is highly relished by travelers, and it is almost impossible for those who become accustomed to its use to discontinue it. It acts in some degree as an aperient and diuretic, and, if taken in over-doses, it occasions diseases similar to those produced by strong liquors.

It is supposed that there are several species of Ilex, the leaves of which are gathered for tea. *Ilex theezans*, *Ilex gongonha*, and *Ilex amara* are known to be used in Brazil and other places. The Yerba, produced by, and known to, the Brazilians as Herva de Palmeira, is specially renowned for its excellent qualities.

Faham or orchid tea.—The plant yielding this tea is *Angræcum fragrans*, an epiphytal orchid of the Island of Bourbon, where it is used under the name of Faham. It has been introduced and used as a beverage in France and other European countries. In taste it differs greatly from that of the Chinese tea, having an aroma of great delicacy, and producing an agreeable perfumery similar to that of the tonquin bean. It has tonic and digestive qualities; and it is recorded that in the aromatic principle of the plant there is a diffusible stimulant capable of deadening nervous sensibility; in the bitter principle an excellent stimulant to revive the strength of the nutritive organs; and in the mucilage a demulcent to relax the tissues.

Jesuits' tea.—This is the leaf of *Psoralea glandulosa*, (*Leguminosæ*,) a native of Chili—a small shrubby plant. The infusion of the leaves is slightly aromatic, and is valued more for its medicinal qual-

ities than for its agreeable flavor. It is used as a vermifuge, and is pronounced to be a good remedy for asthma. The leaves are used in Chili for making poultices for wounds, and an infusion of the roots is emetic and purgative. The leaves are also dried and smoked like tobacco.

Arabian tea.—This is prepared from the leaves of *Catha edulis*, (*Celastraceæ*,) a small tree or shrub, seldom growing over 8 feet in height, native of Arabia. Under the name of cafta, small branches of this plant, with the leaves still attached, form a considerable article of commerce among the Arabs, who cultivate the plant to a great extent in the interior of the country. A decoction of the leaves produces effects similar to those following the use of strong green Chinese tea, only that they are more pleasant and agreeable. The leaves are also chewed when in the green state, and are said to have a tendency to produce great hilarity of spirits, and also to act strongly as a preventive of sleep. The use of cafta in Arabia is supposed to be of great antiquity, and to have preceded the use of coffee.

Bencoolen tea.—A beverage prepared from the leaves of *Glaphyria nitida*, (*Myrtaceæ*,) a native of the Malayan Islands, where it inhabits great elevations and attains a great age. The leaves are eagerly sought for use in the preparation of a kind of tea.

Brazilian tea is prepared from the leaves of *Stachytarpha Jamaicensis*, (*Verbenaceæ*.) It is not known that any peculiarly favorable result attaches to the use of this as a tea, but it is known that Chinese tea is frequently adulterated by mixing with the leaves of this vervain. The green leaves are used as an application to ulcers.

Bush tea.—This is an infusion of the leaves of *Cyclopia genistoides*, (*Leguminosæ*,) a small bush, native of South Africa. Its use seems to partake of a medicinal character, and is recommended in cases of consumption and chronic catarrh; it has an agreeable tea-like smell, with a sweet astringent taste.

Theezan tea is prepared from the leaves of *Sageretia theezans*, (*Rhamnaceæ*,) a Chinese plant of shrubby growth, having smooth shining-green leaves, somewhat resembling those of the true tea, and is employed as a substitute for it by the poorer classes in Southern China.

Labrador tea.—A preparation of the leaves of *Ledum palustre*, (*Ericaceæ*,) a small-spreading shrub, native of Labrador.

Mexican tea.—A name applied to an infusion of the young shoots and leaves of *Ambrina ambrosioides*, (*Chenopodiaceæ*.) It is entirely medicinal, having antispasmodic, vermifuge, and carminative properties. *A. Anthelmintica* is much used as a vermifuge.

Mountain tea is the leaf of *Gaultheria procumbens*, (*Ericaceæ*,) a small creeping plant familiarly known as winter-green in the United States and Canada. All parts of the plant possess a pleasant peculiar aromatic odor and flavor, due to a volatile oil, which, when separated by distillation, is known as winter-green oil. The leaves are used either as a flavor to genuine tea, or in infusion alone, which partakes of an astringent character, and is useful medicinally.

Cacao.—This important article of food is produced by *Theobroma cacao*, (*Byttneriaceæ*,) a plant extensively cultivated in the West Indies and tropical America, particularly in Trinidad and Grenada. It forms a small tree, seldom reaching over twenty feet in height, with large, oblong, and pointed leaves, and clusters of flowers, with a rose-colored calyx and yellowish petals. The fruit varies from six to ten inches in length, and three to five inches in breadth, and is oblong, blunt, and marked with ten elevated ribs running lengthwise. Each fruit contains fifty to one hundred seeds, and it is from these that the cacao or choc-

olate is prepared. The fruit when ripening changes from a green to a deep yellow color; when ripe, it is gathered by hand, split open, and the seeds removed. The latter are then cleaned of the pulpy matter surrounding them, and subjected to a process of fermentation, for the purpose of developing their color, and when this process is completed they are dried in the sun and packed for transportation.

The seeds are prepared for use by roasting in revolving metal cylinders and then bruising them to loosen their skins, which are removed by fanning. The cotyledons, commonly called cacao-nibs, are separated in the same manner. The cleaned seeds are then crushed and ground between heated rollers, which softens the oily matter and reduces them to a uniform, pasty mass; this is then mixed with variable quantities of sugar and starch, to form the different kinds of cacao, or sweetened and flavored with vanilla or other substances for the formation of chocolate.

The value of cacao as an article of food is very considerable, from the large quantity of nutritive matter it contains. In one hundred parts of cacao there are fifty-one of fat or butter, twenty-two of starch and gum, twenty of gluten, and two of the peculiar principle *theobromine*, which contains more nitrogen than the active principle of either tea or coffee. As a refreshing beverage, it is much inferior to either of these well-known articles, which are used as an infusion only; but as cacao is taken into the stomach as a substance, it is an important article of nutrition.

Coffee.—This well-known article is the berry of *Coffea Arabica*, (*Rubiaceæ*,) a native of the extreme southwest point of Abyssinia, from which it was introduced into Arabia, which country for two centuries supplied the world with all the coffee used. Toward the end of the seventeenth century a coffee plant was received at the botanic garden of Amsterdam. About the beginning of the eighteenth century a plant was introduced into the western hemisphere, either by the French at Martinique, or by the Dutch at Surinam, which plant was the parent of all the coffee now exported from the West Indies and South America.

The coffee tree occasionally reaches to a height of twenty feet, with a stem three or four inches in thickness, but in cultivation it is kept dwarf to facilitate the gathering of the berries. The flowers are produced in dense clusters at the bases of the leaves; they are snowy white in color, and are succeeded by numerous red, fleshy berries, each of which contains two of the seeds known as the coffee-berry. The berries are gathered when ripe, and the soft outer pulp is removed by a machine called the pulper, after which they are steeped in water to remove all mucilaginous matter; they are then carefully dried, and the parchment-like covering of the seeds removed by means of a mill, which crushes the shells, and allows the separation of the seeds, which are then ready for market.

The roasting of the berry increases its bulk and diminishes its weight; its essential qualities are also greatly changed, the heat causing the development of the volatile oil and peculiar acid to which the aroma and flavor are due.

Medicinally coffee acts upon the brain as a stimulant, inciting it to increased activity and producing sleeplessness; hence, it is of great value as an antidote to narcotic poisons. It is also supposed to prevent too rapid waste in the tissues of the body, and in that way enables it to support life upon less food. These effects are due to the volatile oil and also to the presence of a peculiar crystallizable nitrogenous principle termed *caffeine*. The leaves of the plant likewise contain the same

principle, and the inhabitants of the island of Sumatra prefer an infusion of the leaves to that of the berries.

Coca.—The leaves of *Erythroxylon coca* are largely used as masticatory and sometimes as an infusion by the natives of South America. The plant forms a shrub six to eight feet high, somewhat resembling the hawthorn. The leaves are of thin texture, but opaque, oval, and strongly marked with veins, of which two, in addition to the mid-rib, run parallel to the margin.

The use of coca in Peru is a custom of great antiquity, and is supposed to have originated with the Incas. It forms an article of commerce among the Indians, and when on a journey they carry with them a small bag of the dried leaves for use. The leaves, chewed in moderate doses of four to six grains, excite the nervous system, and enable those who use them to make great muscular exertion, and to resist the effects of an unhealthy climate. In larger doses it occasions fever, hallucinations, and delirium, but when used with discretion the Indians travel for several days with no other food or sustenance than that derived from the constant chewing of *coca* leaves, and it is largely used by the workers in silver mines. Although the remarkable effects of *coca* have been long known, no chemical analysis of the leaves has been made until quite recently. Dr. Niemann has shown that an organic base exists in them, analogous to caffeine in coffee and theine in tea, to which has been given the name of *cocaine*.

Guarana.—This remarkable product is prepared from the fruit of *Paullinia sorbilis*, (*Sapindaceæ*,) a plant found in the valley of the Amazon. The fruit is gathered when ripe, and the seeds are either roasted or thoroughly dried in the sun, and reduced to a fine powder by pounding them with stones or wooden mallets. The powder is then mixed with water to form a paste, which is molded into flat bricks or cakes, or formed into cylindrical rolls six or eight inches in length, which, when dried, become exceedingly hard and solid. In this form it can be preserved for a long time, and is known as guarana. It is prepared for use by grating or scraping a small portion into powder and mixing it with water. A tablespoonful of the powder, mixed with a pint of water, forms a refreshing beverage. Almost every traveler supplies himself with a stock of guarana, and also with a rasp for grating it, usually the palate bone of a large fish, which has a rough surface, and upon which the guarana is reduced. It has properties, when taken internally, analogous to tea and coffee, producing a stimulating effect. It is highly tonic and febrifuge, and is esteemed by many to have properties equal to quinine. It is largely used by the Brazilian miners, and they consider it a preventive of all manner of diseases, and it has been successfully employed by French physicians in cases of headache.

The presence of an alkaloid, which he termed guaranine, was discovered some years ago by Dr. Martius, of Erlangen, but its identity with theine, from analysis of Dr. Stenhouse and others, was soon established. It is at present the richest known source of theine, and adds another to the incidents, so puzzling in human history, of the discovery of this quality in plants least likely to be suspected, such as the leaves of tea, coca, and coffee, the seeds of cola and coffee, the leaves and twigs of the various South American ilexes, and other plants that have so wonderful a restorative effect on the nervous system; and this is not a mere vague notion, such as is the case with many other plant virtues, but depends upon the presence of a chemical principle, the operation of which can be satisfactorily explained.

Guarana contains 5.07 per cent. of theine; good black tea, 2.13; va-

rious samples of coffee beans, 0.8 to 1; dried coffee leaves, from Sumatra, 1.26; Paraguay tea, 1.25. In addition to theine, guarana contains a coloring matter, apparently analogous to the tannin in cinchona bark, and also a fatty matter, which, like the fat of chocolate, does not readily become rancid.

Another species of this genus, *Paullinia cupana*, also enters into the composition of a favorite national diet drink. Its seeds are mingled with cassava and water, and allowed to pass into a state of fermentation bordering on the putrefactive, in which state it is the favorite drink of the Orinoco Indians.

Kola nut.—A comparatively new source of theine has lately been discovered in the kola nut. This is the seed of *Cola acuminata*, (*Sterculiaceæ*,) a tree attaining a height of 40 feet, a native of western tropical Africa, where it grows mostly in the vicinity of the coast. Under the name of kola or cola, or goora nuts, the seeds of this tree have been used for centuries as a kind of condiment by the natives of Southern Africa, and no product of that country occupies so exalted a position in the social or dietetic economy of native tribes, or constitutes so important an article of traffic as these seeds.

From the fact that the use of the kola nut tends to sleeplessness, it was conjectured that it might contain a principle similar to that which exists in tea and coffee, and a chemical analysis of the dried seeds shows that they contain about 2.13 per cent. of theine—about equal to the quantity found in good black tea. This, however, is not deemed a true test of the value of these nuts, as it is in the fresh state that they are generally used by the natives, and when dried they are considered to have depreciated in value, and are used by the poorer or lower classes.

New Jersey tea.—Under this name the leaves of *Ceanothus Americanus* (*Rhamnaceæ*) have been used in infusion, particularly during the war of Independence. Although it has none of the peculiar properties of Chinese tea, it produces a pleasant aromatic beverage. It has some medicinal qualities, and has been used as a dye for wool, producing a nankeen or cinnamon color.

Swedish coffee.—The seeds of *Astragulus Bœticus* (*Leguminosæ*) are used in place of, and more frequently with, the coffee bean, and the plant is cultivated in some parts of Europe for this purpose, the seeds being known as Swedish coffee.

Yaupon tea.—This is prepared from the leaves of *Ilex cassine*, (*Aquifoliaceæ*,) a native of the Southern States. It was formerly much used by the Indians; an infusion from the leaves, probably mixed with leaves from other species of the same genus, formed their *black drink*, which was said to act upon them like opium. It is still used as a tea occasionally, and medicinally as an aperient and diuretic.

Betel nut.—This famous masticatory is the fruit of *Areca catechu*, (*Palmaceæ*,) a handsome palm cultivated in many tropical climates, both east and west. The fruit is about the size of a hen's egg, of a reddish yellow color, and with a thick fibrous rind inclosing the seed. The latter is known under various names, such as pinang, betel nut, bonga, areca nut, &c., and is about the size of a nutmeg—conical, flattened at the base, brownish externally, and internally mottled like a nutmeg. The nuts vary somewhat in size, but their value depends upon their appearance when cut open. When the white or medullary portion which intersects the red or astringent part is small, and has assumed a bluish tinge, and the astringent part itself is of good red color, the nut is considered of the best quality; but when the medullary portion is in larger quantity, the nut is more mature, lacks astringency, and is not so much

esteemed. When prepared for use, the nuts are cut into narrow pieces, and wrapped up with a small quantity of lime in the leaves of the betel pepper, (*Charica betel*,) and chewed. The mastication of the betel is considered wholesome by those using it, stimulating the nervous system like tea, coffee, and tobacco. It stains the teeth and lips black, and produces a kind of intoxication when too freely indulged in. It is calculated that one hundred millions of people use this nut. It contains a large quantity of tannin, and is used for dyeing cotton and making ink, and a species of catechu, by boiling the nuts in water when the fruit is tender; the water becomes red, thick, and starch-like, and is afterward evaporated to a proper consistency.

Cow tree.—This name is applied to *Brosimum galactodendron*, (*Artocarpaceæ*,) a tree attaining a height of 100 feet in the forests of Venezuela. Its milk, which is obtained by making incisions in the trunk, so closely resembles the milk of the cow, both in appearance and quality, that it is commonly used as an article of food by the inhabitants of the places where the tree is abundant. Unlike many other vegetable milky juices, it is perfectly wholesome and very nourishing, possessing an agreeable taste like that of sweet cream, and a pleasant balsamic odor, its only unpleasant quality being a slight degree of stickiness. The chemical analysis of this milk has shown it to possess a composition closely resembling some animal substances; and, like animal milk, it quickly forms a yellow cheesy scum upon its surface, and after a few days of exposure to the atmosphere turns sour and putrefies. It contains upward of 30 per cent. of a resinous substance called galactine.

Clusia galactodendron, (*Clusiaceæ*.)—A native tree of Venezuela, which, according to M. Desvaux, is one of the Palo de Vica or cow-trees of South America. It has a thick bark, covered with rough tubercules, and its internal tissue becomes red when exposed to the air. In extracting the milk from this tree the inhabitants make incisions through the bark till the wood is reached. These cuts are said to be made only before full moon, it being imagined that the milk flows more freely then than at any other time. One tree will yield a quart in an hour. The milk is freely used by all, especially by children, but it has an astringent taste, which is characteristic of all such vegetable milks.

Cow tree of Guiana.—This is the *Tabernæmontana utilis*, (*Apocynaceæ*,) which, when tapped, yields a copious supply of thick sweet milk, resembling that of the cow in appearance, and perfectly bland and wholesome, but rather sticky, from the presence of caoutchouc.

Chicory or *succory*, *Cichorium intybus*, (*Compositæ*.)—A perennial plant, native of Europe, but naturalized here, and now a common plant, not to say a troublesome weed, over a large portion of this country. Its long tap-root is used to mix with coffee. It is roasted and ground to a coarse powder, and many persons prefer the mixture to the pure coffee bean. It is entirely destitute of those properties which render coffee an agreeable and nutritive beverage, while it possesses medicinal properties closely resembling those of the dandelion, which would render it unfitted for constant use in its pure condition. It is said that much of the prepared chicory is mixed with carrot, turnip, oak-bark tan, mahogany sawdust, &c. The leaves when blanched in winter are used as a salad, and are much esteemed for this purpose. In France it is known as *Barbe du Capucin*.

Symplocos Alstonia, (*Styracaceæ*,) is a branching shrub, growing 8 or 10 feet high, with shining evergreen foliage. It is a native of New Grenada, where the leaves are scorched, similar to the mode of preparing mate,

and used in the same manner. It is quite astringent, and possesses valuable medicinal qualities.

Capitao do matto, of Brazil, is an infusion of the leaves of *Lantana pseudo-thea*, (*Verbenaceæ.*) This infusion is highly esteemed in Brazil as a substitute for tea. It is aromatic and agreeable.

Tea of Heaven.—This name is applied by the Japanese to the dried leaves of *Hydrangea Thunbergii* and *Platycrater arguta*, of the family of *Hydrangeaceæ*. The leaves are used as tea.

SPICES AND CONDIMENTS.

Cinnamon.—The true cinnamon is obtained from *Cinnamomum Zeylanicum*, (*Lauraceæ*,) a tropical tree reaching a height of 30 feet, and cultivated in many countries. Ceylon has long been noted for the excellence of its cinnamon, but commerce is largely supplied from the West Indies and South America, and there is much inferior bark sold as the genuine article. It is prepared by stripping the bark from the branches, when it naturally rolls up into quills, the smaller of which are introduced into the larger, and then dried in the sun. Good cinnamon is known by the thinness of the bark; as a rule, the thinner and more pliable the finer the quality. When it is broken the fracture is splintery. It is largely used as a condiment for its pleasant flavor, and its astringent and cordial properties give it a value as a medicine. From the root an excellent camphor is extracted, and the flowers are used as a spice.

Cassia is furnished by *Cinnamomum cassia*, a tree growing 40 to 50 feet in height, cultivated to a considerable extent in China, the Philippine Islands, the western coast of Africa, and in Brazil. The China cassia is considered superior in perfume and flavor to any spice of its class. This bark resembles the true cinnamon, but is thicker, coarser, and not so delicate in flavor, but being cheaper is frequently used to adulterate the true article. For confectionery purposes this affords a stronger flavor than cinnamon, and is therefore preferred. The bark is collected and prepared as for cinnamon. Cassia bark is distinguished from cinnamon by being more brittle, and of less fibrous texture; it is not so pungent, and has more of a mucilaginous or gelatinous quality.

Cassia buds are the dried flower-buds of the cassia tree. The best come from China, and are round, bearing some resemblance to a clove, but smaller, and have a rich cinnamon flavor.

Cloves.—The cloves of commerce are the unexpanded flower-buds of *Caryophyllus aromaticus*, (*Myrtaceæ*,) a small evergreen tree, native of the Moluccas, but cultivated in several parts of the East and West Indies. The flowers are produced in branched panicles at the extremity of the branches, and are of a delicate peach color. Before expansion the buds are collected by hand, or sheets and mats are spread under the tree, and the buds are brought down by beating it with sticks. They are cleaned and dried in the sun; a uniform brown color is imparted by slightly smoking them over a wood fire. All parts of the plant are aromatic, but especially the flower buds; hence their use for culinary purposes.

Star anise, *Illicium anisatum*, (*Magnoliaceæ.*)—The fruit of this Chinese shrub forms an article of commerce, and is used as a condiment in the preparation of food. In China and Japan it is chewed in small quantities after meals, both for the purpose of sweetening the breath and to promote digestion, while the native physicians prescribe it as a stomachic and carminative. Its pungent aromatic odor and flavor bear a strong resemblance to those of common anise.

Fenugreek, *Trigonella fœnum-Græcum*, (*Leguminosæ*,) is a small annual

plant, native of the south of France. The seeds of this plant were held in high repute among the ancient Egyptians, Greeks, and Romans for medicinal, flavoring, and culinary purposes. At present they are not much used, and mostly in veterinary practice. They have a strong odor of coumarine—the fragrance of the tonquin bean—and consequently are used for cattle food, and flavoring damaged hay.

Melilotus cœruleus, (*Leguminosæ.*)—The flowers of this plant contain a volatile odor or principle which gives the peculiar flavor and fragrance to the celebrated Champziger or Schabzieger cheese of Switzerland. The dried flowers are reduced to powder, and worked up into a paste with the curd.

Cardamoms.—These are the seeds of various species of *Amomum* and *Elettaria*, of the family *Zingiberaceæ*. The cardamoms of commerce are oval triangular capsules, containing bright yellow seeds, which are used for flavoring dishes, such as soups, curries, catsup, &c. The plants are low-growing, with creeping roots, natives of India and the Indian Archipelago.

Amomum melegueta furnishes Malaguetta pepper, or Grains of Paradise. This plant is a native of Guinea and the western part of Africa. The seeds are very hot and peppery, and have a slightly camphor-like taste. They are mostly used in liquor adulterations, giving a fictitious strength to spirits and beer, and cannot be considered particularly injurious, compared with some adulterations. In many parts of India and Africa they are considered the most wholesome of spices. *Elettaria cardamomum* furnishes the small or Malabar cardamons. These, as imported, consist of fruit with ovate, oblong, obtusely-triangular capsules, of a grayish or brownish-yellow color, containing many angular, blackish, rugose seeds, which are white internally, have a pleasant aromatic odor and an agreeable taste, much valued as a condiment. They are also often used medicinally in conjunction with other drugs.

Guinea pepper.—This is obtained from the fruit of *Habzelia Æthiopica*, (*Anonaceæ*,) a tall-growing shrub of Western Africa. The fruit consists of a number of smooth pod-like carpels about the thickness of a quill and two inches in length, and when dried and reduced to powder is the Ethiopian pepper of the Old World. It is highly aromatic and pungent.

Pimento, allspice, or Jamaica pepper, is furnished by *Eugenia pimenta*, (*Myrtaceæ*,) a native of the West Indies. It forms a high, beautiful tree, and is extensively cultivated in Jamaica, where the trees are planted in orchard-like rows, which are called pimento walks. The fruit has an aromatic odor, and in taste resembles a combination of the flavors of cinnamon, cloves, and nutmeg. The berries are about the size of a small pea, of a dark color, and, as seen in commerce, are surmounted by the remains of the calyx. They are prepared by being gathered before they are fully ripe, and then dried in the sun, when they acquire that reddish-brown tint which makes them marketable. Pimento is used as a spice in cookery, and as a carminative in medicine.

Nutmeg.—The nutmeg tree, *Myristica moschata*, (*Myristicaceæ*,) is extensively cultivated in tropical regions for its valued products. It is comparatively a small tree, seldom reaching a height of more than 30 feet. The leaves are aromatic, and the fruit is very much like a peach, having a longitudinal groove on one side, and bursting into two pieces, when the inclosed seed, covered by a false aril which constitutes the substance known as the mace, is exposed. The seed itself has a thick outer shell which may be removed when dry, and which incloses the nucleus of the seed, the nutmeg of commerce. The fruit is gathered at various seasons as it attains maturity. The mace, or covering, which is

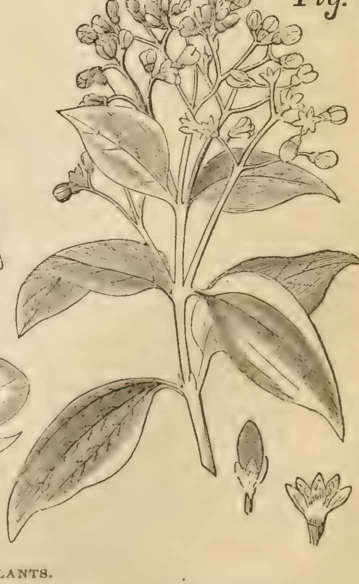
PLATE VI.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.



SPICE PLANTS.

Fig. 1. Ginger. Fig. 2. Nutmeg. Fig. 3. Caper. Fig. 4. Cinnamon.

of a fine red or crimson color when fresh, becomes a golden yellow when dry, and artificial heat is sometimes applied to produce this purely fanciful color, as it adds no intrinsic value to the article. The nuts are liable to be injured by insects; to guard against which they are washed over with lime, or steeped in lime and water for several weeks after gathering. Occasionally they are exported in the shell to prevent destruction by insects. The most esteemed are those of Penang, which are about an inch in length, shaped like a damson plum, pale-brown in color, and furrowed on the exterior, and gray inside, with veins of red running through them. Penang mace is also valued above that from other localities; it is usually of a pale cinnamon color when dry. Inferior nutmegs are those sent into market after the oil has been distilled from them, when they are comparatively valueless. Various ingenious methods of dressing up inferior nutmegs have been resorted to, for the purpose of increasing their value, and even a kind of artificial article has been fabricated by admixture of bran, clay, and powdered nutmeg, pressed into shape in molds, and colored wooden nutmegs have had a reputation.

Black pepper.—This condiment has been in use from the earliest historic times, and is frequently mentioned by early Roman writers. The pepper-plant, *Piper nigrum*, (*Piperaceæ*,) is a shrubby, climbing vine which attains a height of 15 to 20 feet. It is a tropical plant cultivated in the East and West Indies and South America. The plants are placed at the base of trees that have rough or prickly bark, or trained on stakes. The fruit when ripe is of a red color, but for commerce it is gathered before it is fully ripe, and laid in the sun to dry, when it becomes black and shriveled. White pepper is the same fruit allowed to remain on the vine until more fully matured, and the skin removed by maceration in water and subsequent friction; the pale color is sometimes increased by submitting the fruit to the action of chlorine. Like many other articles of daily use, ground pepper is frequently adulterated with mustard, ground rice, wheat, &c., and artificial pepper-corns have been manufactured with oil-cake, clay, and a little cayenne. Pepper-dust, the refuse and sweepings of warerooms, is used to mix with the ground article. According to chemical analysis, pepper contains a hot, acrid resin and a volatile oil, as well as a tasteless crystalline substance called piperine, which has been recommended as a substitute for quinine. Its use in cases of ague, to ward off the paroxysm, was practiced by the ancients.

Cayenne pepper.—This is produced chiefly from the fruit-pods of *Capsicum frutescens*, (*Solanaceæ*,) although other species and varieties are used for the same purpose. These are natives of South America and the East and West Indies, but are largely cultivated everywhere in warm regions, their pungent fruits being used in immense quantities in tropical countries. In Guiana the inhabitants eat them in such abundance as to astonish travelers. Their consumption in India is also very great; ground into paste between two stones, with a small quantity of oil, ginger, and salt, they form the only seasoning which thousands of people can obtain to flavor their insipid rice. To form Cayenne pepper, the ripe fruits are dried in an oven, or on a hot plate, and then reduced to powder in a mortar, or passed through a mill. It is then sifted through a thin muslin sieve, and preserved in closely stopped bottles. An inferior article is prepared by mixing the coarsely ground powder with wheat flour, which is mixed with water and made into cakes that are baked hard, then ground fine, and sifted. More dangerous adulterations are made by adding red lead and other substances.

The hot taste seems to be due to a peculiar acrid fluid called capsicine, which is so pungent that half a grain of it, volatilized in a large room, causes all who respire the contained air to cough and sneeze. Chili vinegar is prepared by simply placing a handful of pods in a pint of good vinegar, and allowing the mixture to stand for two or three weeks. It has been observed that generous culture increases the size of the fruit, but impairs its pungency and acridity. Pepper pot, or *man dram*, is an appetizing preparation of the West Indies, in which capsicum is one of the chief ingredients.

Japan or *Chinese pepper* consists of the fruit of *Xanthoxylon piperitum*, (*Xanthoxylaceæ*,) which has an aromatic, pungent, peppery taste.

New Holland pepper is the fruit of *Tasmania aromatica*, (*Magnoliaceæ*,) a native of Van Dieman's Land, where it forms a dwarf spreading tree. The fruit is black, very like true pepper, possessing a great degree of similar aromatic pungency, and is used as a substitute for that condiment.

Long pepper and *Betel pepper* are furnished by *Chavica Roxburghii* and *C. betel*, (*Piperaceæ*,) respectively. They are strictly tropical plants. Long pepper is furnished by the immature spikes of flowers which are gathered and dried in the sun. In chemical composition and qualities it resembles ordinary black pepper, and contains *piperine*. The leaf of the betel pepper is used for chewing with the betel-nut, *Areca catechu*.

Capers.—*Capparis spinosa* (*Capparidaceæ*) is a creeping plant, a native of the south of Europe. The flower-buds, and in some parts of Italy the unripe fruit, are pickled in vinegar, and form what is known as capers. An African species, *C. Sodada*, furnishes berries with a pepper-like, pungent taste, and when dried are used as food. The flower-buds of *Zygophyllum fabago*, (*Zygophyllaceæ*,) a native of the Cape of Good Hope, are used instead of capers, or substituted for that condiment. *Z. coccineum* has aromatic seeds, which are used by the natives in place of pepper. These and several other species are possessed of vermifuge properties. The leaves of *Z. simplex* are used for diseases of the eye. The smell of this plant is so detestable that no animal will eat the foliage.

Coriander seed.—The fruit of *Coriandrum sativum* (*Umbelliferæ*) is commercially, but erroneously, known as coriander seeds. The plant is a low-growing annual, native of the south of Europe. It is of the easiest culture; the seeds sown in spring produce plants which ripen their fruit in the fall; a sandy soil is preferable. They are aromatic and carminative, and are used for flavoring curries and for other culinary purposes; also by distillers, druggists, and confectioners.

Caraway seeds are the fruits of *Carum carui*, (*Umbelliferæ*.) a small biennial plant, cultivated for its fruit in various parts of Europe, chiefly in Germany and Britain. The seed is sown as soon as it ripens, in the latter part of summer, and when the plants are sufficiently advanced they are thinned so as to allow one to each square foot of surface. The fruit ripens during the following summer. The seeds are used for flavoring purposes in cookery and confectionery, being highly aromatic.

Ginger.—This well-known spice is furnished by the rhizomes of *Zingiber officinale*, (*Zingiberaceæ*.) a plant much cultivated both in the East and West Indies, as well as in South America, Africa, and China. The rhizome, or woody root-stock, which forms the ginger, is dug up when of sufficient size, cleaned, scraped, and dried, and in this state is called *uncoated* ginger; but when the outer skin is not removed from the root-stocks it is called *coated*, and presents a dirty-brown appearance. Independent of this difference in color, which is in the mode of preparation,

it is supposed that there are two varieties of the species, one producing white, and the other darker-colored ginger. The darker kinds are sometimes bleached by exposure to the fumes of chloride of lime, or burning sulphur. Ginger when broken across shows a number of small fibers imbedded in floury tissue. Its well-known hot, pungent taste is due to the presence of a volatile oil; it also contains a large quantity of starch and yellow coloring matter, inclosed in large cells. Ground ginger is largely adulterated with starch, wheat flour, ground rice, mustard, husks, &c., in various proportions. In a young state the rhizomes are tender, fleshy, and mildly aromatic. In this state they are preserved in sirup, and form the delicious conserve known as *preserved ginger*. West India gingers are preferred to those from the East Indies. Ginger is an aromatic stimulant, principally used as a condiment, and much employed in the manufacture of various liquors, cordials, and beers. An infusion, under the name of ginger-tea, is much used in India. *Amada ginger* is furnished by the root-stocks of *Curcuma amada*, (*Zingiberaceæ.*) *C. aromatica* and *C. zedoaria* furnish zedoary tubers which are used as ginger, and as aromatic tonics by the natives of India.

Turmeric.—This mild aromatic is furnished by the root-tubers of *Curcuma longa*, which is extensively cultivated in China. The older tubers are reduced to powder, which enters into the composition of curry-powder, and is used in sauces. It is also used for medicinal purposes, and as a chemical test for the presence of alkalies, which change its yellow color to a reddish-brown. In China it is used as a yellow dye, and the young tubers furnish a kind of arrowroot. Many others of this species furnish starchy products, and tonic stimulants.

Liquorice.—The plant which yields the liquorice-root and paste of commerce is *Glycyrrhiza glabra*, (*Leguminosæ*,) a native of the south of Europe. It is a herbaceous perennial, and is cultivated to considerable extent in Spain and Italy. It is readily propagated from root-slips, and succeeds well in deep, light, loamy soil. The roots require a growth of two to three years to be fit for use. Spanish liquorice is an extract made by slicing the root and boiling it in water; the liquor is afterward strained and allowed to evaporate to a proper consistency. It is further refined by redissolving, purifying, and again evaporating, and is then formed into quill-like rolls, and known as refined liquorice. It is used in confectionery, in breweries, and also in medicine. *G. echinata*, and probably other species, furnishes the same principle of sweetness, which is called *glycerine*.

Wild liquorice.—This name is applied to *Abrus precatorius*, (*Leguminosæ*,) a tropical twining plant. The roots furnish liquorice in the same manner as the roots of the true liquorice-plant. This plant is remarkable for its small, egg-shaped seeds or beans, which are of a brilliant scarlet color, with a black scar indicating the place where they were attached to the pods. These seeds are much used as beads for necklaces and other ornamental purposes. They are so uniform in size and weight as to be used as a standard for weighing precious stones.

Tamarinds are the fruit-pods of *Tamarindus Indica* (*Leguminosæ*,) a beautiful pinnated-foliaged tree of the tropics. There are varieties of this tree, distinguishable chiefly by the size of the pods. The pods vary in length from 3 to 6 inches, and are slightly curved. They consist of a brittle shell, inclosing a soft, acid, brown pulp, traversed by strong woody fibers; the seeds are again immediately invested by a thin membranous covering. They owe their grateful acidity to the presence of citric, tartaric and other vegetable acids. Tamarinds form an important ingredient in the cookery of Eastern nations, as in the curries of

India. They are also used for preserving fish, which, under the name of tamarind-fish, are considered a delicacy.

Vanilla.—The vanilla of commerce is the seed-pod of *Vanilla aromatica* and *V. planifolia*, climbing orchids of South America. The best is said to be produced from *V. planifolia*, a Mexican species. When the vanilla pods are gathered, they are immersed for an instant in boiling water to blanch them; they are then dried and lightly smeared with oil to prevent evaporation. The dried pods, like the berries of pepper, change color while drying, grow brown, wrinkled, and soft, and shrink to one-fourth their original size. This aromatic is much used by confectioners, also by perfumers, distillers, &c.

Mustard.—This condiment is prepared from the seeds of *Sinapis nigra* and *S. alba*, *(Cruciferæ,)* natives of Europe, but introduced and growing wild in many places here. The seeds are crushed between rollers, pounded, and sifted frequently, to produce powdered mustard. The black and the white are generally mixed, and the powder is frequently mixed with wheat flour and turmeric powder. The seeds contain but little, if any, starchy matter. Chemically, they contain a peculiar acid called myronic acid, which contains a portion of sulphur.

VEGETABLE WAXES.

Carnauba wax is produced by the wax palm of Brazil, *Copernicia cerifera*, which attains a height of 30 to 40 feet, and with a trunk only 6 to 10 inches thick, composed of very hard wood, used for building purposes and ornamental veneering. The foliage, especially the young leaves, is coated with wax, which is obtained by first detaching the leaves from the plant, and shaking them so as to loosen the wax, each leaf furnishing about fifty grains of whitish, scaly powder, which is melted in pots and run into cakes. It is sometimes used to adulterate bees-wax, and has been tried for purposes of candle-making, but the lemon-colored tint of the raw wax has hitherto baffled all attempts at bleaching.

Humboldt's palm wax.—The wax palm of New Grenada, *Ceroxylon Andicola*, is found growing in great abundance in very elevated regions on the chain of mountains separating the courses of the rivers Magdalena and Cauca, in New Grenada, extending almost as high as the lower limit of perpetual snow, which is unusual in this tribe of plants, as the palms generally favor tropical climates. The trunk of this palm is of great height, starting from the ground with a diameter of about 10 to 12 inches, which thickness is maintained for the first half of its height; it then swells out and again becomes contracted to its original dimensions as it reaches the top. These lofty trunks are covered with a coating of resin-like wax, which gives them a whitish, marble appearance. The wax is gathered by cutting down the plant and scraping the trunk with a blunt instrument, the average yield being twenty-five pounds to a tree. It is then melted and run into calabashes, in which state it forms an article of commerce among the inhabitants. It is mixed with tallow and made into candles, as it burns too rapidly when used alone.

Candleberry or myrtle wax.—This product is yielded by the genus *Myrica*, which is widely scattered over the temperate regions of both hemispheres; in North and South America, Europe, Cape of Good Hope, Northern India, China, and Japan. The plants are mostly shrubs, with fragrant foliage. The fruits are nuts or drupes, covered with a coating of a waxy, resinous secretion, which is separated from the berries by boiling them in water, stirring them during the ebullition to facilitate the separation of the wax, which appears on the surface, and is

skimmed, and afterward strained through a coarse cloth to free it from impurities.

Myrica cerifera and *M. Carolinensis* are North American species; the latter is said to be the most valuable, giving wax of a greenish yellow color, of a finer consistence than the bees-wax, and yielding at the rate of one pound of wax to four pounds of berries. Candles manufactured from it diffuse a delightful odor when burning, and even for some time after extinction. There are several species of *Myrica* indigenous to Southern Africa, the wax from which is an article of commerce. *Myrica faga* is a native of the Azores, and furnishes wax which is frequently utilized in candle-making.

Japan wax.—This hard, white wax, now a considerable article of export from Japan, is yielded by the fruit of *Rhus succedanea*, (*Anacardiaceæ*,) a small tree much cultivated in Japan for this product. It is softer and more fatty than bees-wax, and is easily kneaded; its fusing point is from 125° to 130°. Candles are commonly made from it by the Japanese. It is exported in square blocks averaging 130 pounds each. *Rhus vernicifera*, also indigenous in Japan, yields the famous lacquer so extensively used by the people of that country for lacquering various articles of furniture and other wares. This substance exudes from wounds made in the tree, and is at first milky white, but gradually becomes darker and ultimately black on being exposed to the air. Nothing certain has been made known regarding the mode of preparing it for use, and it is remarked that the lacquer ware now manufactured is greatly inferior to the ancient samples of this kind of ornamental work.

Peetha wax.—The fruit of the white gourd of India, *Benincasa cerifera* (*Cucurbitaceæ*,) secretes upon its surface a waxy substance which resembles the bloom found on plums and some other fruits; but in this fruit it is produced in sufficient quantities to be collected and made into candles.

Birch wax.—It is stated that the dwarf birch, *Betula nana*, yields a wax similar to that afforded by the *Myrica*, and it is used for similar purposes.

Fig wax.—A species of fig, *Ficus cerifera* (*Moraceæ*,) found in the island of Sumatra, yields a kind of waxy secretion which is known under the name of getah lahoe, and is used for making candles.

Wax tree of the Cordilleras.—This is the *Elæagia utilis*, (*Cinchonaceæ*,) a lofty-growing tree, remarkable for the quantity of green resinous or waxy matter which is secreted by the stipules which invest the unexpanded buds. The wax is collected by the Indians and used by them to varnish useful and ornamental objects. It is first purified by immersion in hot water, and then worked until it becomes ductile. It is naturally of a yellow color, but various colors may be imparted by adding them to it when melted. The resin or wax when thus prepared is laid on in thin layers by the aid of heat and pressure, and by means of different-colored layers, placed one upon another, and cut into various shapes, a kind of design is produced. By first coating the object with a layer of silver foil a fine metallic luster is developed.

The following table shows the value of the articles named respectively, imported and entering into consumption in this country during the fiscal year ending June 30, 1869:

Croton oil	$5,618 00	Almond oil	$7,260 00
Origanum	13,696 00	Cassia oil	17,318 00
Citronella	22,564 00	Cinnamon oil	588 00
Cajeput	1,207 00	Castor oil	21,891 26
Palm and cocoa oil	232,354 00	Olive oil	521,117 50

Anise oil	$13,930 00	Coffee	$22,779,574 46
Linseed oil	70,648 00	Chiccory	126,794 31
Bergamot oil	130,386 00	Cinnamon	1,821 40
Gamboge	9,367 00	Cassia and cassia buds	178,822 00
Asafœtida	5,215 00	Cloves	42,093 10
Jalap	8,939 00	Fenugreek seeds	3,089 00
Manna	4,115 00	Cardamom seeds	23,998 00
Aloes	15,626 00	Pimento	54,527 25
Tolu balsam	3,445 00	Nutmegs	205,128 85
Mastic	2,615 00	Pepper	299,813 15
Balsam copaiba	27,892 00	Cayenne pepper	7,518 83
India-rubber	2,672,569 00	Coriander seed	3,768 00
Gutta-percha	15,587 00	Caraway seeds	24,889 00
Tea	12,889,383 30	Ginger	100,140 10
Chocolate	4,550 00	Vanilla beans	42,505 00
Cocoa	210,939 81	Mustard	63,731 25

THE OPIUM POPPY.

From experiments which have been made in the cultivation of the poppy in several of the States, it is evident that opium of good quality can be produced in this country. Good Turkey opium is worth at wholesale $10 50 to $11 per pound, and $20 to $22 at retail. The importations into the United States during the year ending June 30, 1870, amounted to 254,609 pounds, valued at $1,776,908. There has been a gradual increase in the importation from year to year, corresponding to the increase of population. If a portion of the opium employed by the medical profession could be produced in our own country it would afford a pleasant and, doubtless, profitable employment to persons of small means, as no capital is required in outlay for machinery in the ordinary mode of collecting it. The aim should be to produce a prime unadulterated article by scarification, and in this way to establish a reputation for the production of opium of the best quality. Reckoning thirty pounds to an acre, at $8 a pound, the income would be $240, a sum which is far above the value of most cultivated crops.

SPECIES AND CULTURE.

All species of the poppy yield opium, but not in equal quantity, nor of the same quality. The common garden poppy (*Papaver somniferum*) is the species cultivated in Turkey, India, and in this country for medicinal purposes. There are two principal varieties of this species, one with white seeds and usually with white flowers, and the other with black seeds and violet or red flowers. The former is generally cultivated for opium, and the latter for oil, although both products may be obtained from each variety. The poppy thrives best on a light sandy loam, and is not an exhausting crop. In the commencement the ground should be prepared as for garden culture, and enriched with a liberal supply of nitrogenous manures. When the plant has arrived at full maturity at the end of the season it decomposes very quickly; and, if plowed under, is said to furnish, after the first year, a very large proportion of the manure necessary to keep the ground in good condition.

The mode of culture usually adopted in this country differs in some particulars from that pursued in Turkey and India, where the seeds are sown broadcast, and thinned out to such distances as best suit the convenience or the taste of the cultivator. It has been found with us most convenient to sow the seeds in drills about eighteen inches apart, and

to thin out to six or eight inches between the plants. In order to get as many plants as possible on a given area, some prefer to make the first two rows a foot apart, and then to leave a space of eighteen inches, thus alternating throughout the field. Three or four ounces of seed are said to be sufficient to sow an acre, but in order to insure a "good stand" a much larger quantity is generally used. The covering should be very slight, not exceeding one-fourth of an inch. The time for sowing should be such that the plant may mature its blossoms and the opium be gathered in the dry season of the year; for, if the soil is wet at the time of blossoming, opium will not be formed in large quantity, nor will it be of good quality. The plant matures sufficiently for gathering its opium in ninety to one hundred days. In Jefferson County, New York, the time of sowing is from the 5th to the 20th of May; at Benares, in Hindostan, in November. In the former place the flowers mature in July; in the latter in February, before the rainy season commences; therefore a favorable season is secured for maturing and gathering the opium.

COLLECTING THE OPIUM.

No other process yet devised for collecting opium has proved equal to that of scarifying the capsules. A knife has been invented which is said to be well adapted to this purpose. It has four lancet-points fixed in the end of a wooden handle, the end being curved in such a manner as to conform to the spherical shape of the capsule, and the blades of such length as to penetrate only through the epidermis, or outer skin. A deeper incision would be injurious. The capsule is held in the left hand, and the knife applied at the bottom and drawn upward, making four incisions at once. Some make three incisions and others one, horizontally around the capsule, and think more opium can be obtained in this way than by making them in a vertical direction. Some practical culturists say that the most favorable results can be obtained by making one spiral incision around the capsule, from the top to the bottom. When the incisions are made vertically the operation may be performed from two to six times during the season on each capsule, according to its size and yield; but, when they are made horizontally or spirally, one operation on each capsule is usually found sufficient to extract all the opium; and it is asserted that the experience of European culturists has proved that one incision is as effectual as three or four. The process of scarifying the capsules must commence in a few days after the petals of the flowers have fallen. The first part or middle of the afternoon is usually selected for scarifying, on the supposition that the dampness of the night is more favorable to the exudation of the opium than the dry atmosphere of the day. The opium exudes in the form of white tears, and hardens into a brown substance around the incisions. It is scraped off the next morning as soon as the dew is off, with the crooked blade of a small knife, and placed in a vessel prepared to receive it. This is the best quality of opium. When it has hardened to a convenient consistency it is worked into balls, and may be ready for market in forty-eight hours after being collected.

Another mode of extracting the opium is by grinding or pounding the capsules, a little water being added, and then expressing and straining the juice, and evaporating it by a gentle heat. The watery portion will pass off, and the inspissated opium will be left in the vessel. A more detailed account of this process is taken from the Scientific Press, as follows:

In collecting opium by expression the capsules are cut from the stems and ground or mashed to a pomace. The vat for holding it should be lined with tin or brass. Before

putting the pomace into the press, half a pint of alcohol is added to every forty or fifty pounds of pomace, the whole being well stirred together and allowed to stand for about an hour. The mass is then ready for the press. The alcohol used unites with the juice and renders it limpid and more easy to be taken away from the pomace by the action of the press. The liquid, as it comes from the pomace, is received into a "settler," in which it should be allowed to stand about one hour; during which time the green matter of the plant will settle to the bottom, so that the opium liquid may be drawn off from the surface by faucets properly arranged for the purpose. This should be immediately placed in shallow tin pans, so as to stand about half an inch deep, and the pans arranged on suitable racks in a drying or evaporating room. This room should be tight, and so arranged that the heat and moisture may escape from a single opening at or near the top. The temperature should never be allowed to fall below 130° F., nor to exceed 160°. If the heat gets too low the juice will become sour and spoiled; if too high it will scald. The evaporating process must be carefully watched day and night until completed, and it should be continued until the opium is dry enough to be scraped from the plates, care being taken not to allow it to get too dry for that operation. When taken from the pans it should be molded into balls of about one pound weight, when it is ready for market. In cutting the capsules for grinding, care should be taken that they be as ripe as is required for collecting opium by scarification.

Sometimes, when the scarifying process has been continued till the juice ceases to exude, the capsules are then cut from their stems and the remaining opium extracted by the foregoing process, but the product is inferior, and is often used for the extraction of morphia, or sometimes fraudulently for adulterating opium of good quality. Although a larger quantity of opium can be obtained by the evaporating process than by scarification, in all cases the quality is inferior and the seeds are lost, which are worth about one-third as much for oil as the opium obtained.

QUALITY AND CLIMATE.

The quality of opium is generally estimated by the quantity of morphia which it contains. A certain amount of heat is necessary in the cultivation of the poppy in order to produce opium of the best quality and in the largest quantity. This requisite is commonly supposed to be found only in what may be called warm climates. The poppy is extensively cultivated for opium in Asiatic Turkey, India, Egypt, and France. Turkey opium, most of which is obtained from Smyrna, has the highest reputation for medicinal purposes, and is that which is principally used by physicians in this country. It is declared, however, on the best authority, that opium is produced in France fully equal to the best quality from Smyrna, and is less frequently adulterated than that obtained from the latter place. The mean annual temperature of the opium districts of the foregoing countries, named in their order, is respectively 65°, 80°, 75°, and 50°. There are doubtless other conditions besides temperature which are essential to the production of opium of the first quality, as soil, equability of climate, and a proper proportion of wet and dry weather—things which can be accurately determined only by actual trial in the different localities in which it is proposed to cultivate it. We give the results of analyses of dried specimens of opium from the countries named, recently made by M. Guibourt, in which he gives the percentage of morphia found in each, as follows: Turkey opium, from Smyrna, highest percentage, 21.46; lowest, 11.70; mean, 14.78. India, from Patna, highest, 7.72; lowest, 5.27; mean, 6.45. Egypt, from Alexandria, highest, 12.21; lowest, 5.81; mean, 9.01. France, from Amiens, highest, 22.28; lowest, 14.83; mean, 17.69. The mean percentage here given of each kind of opium is the mean of all the specimens analyzed, and therefore does not in every case correspond with the mean of the highest and lowest. From an examination of the mean temperature of the climates of the countries named, it will be seen that the opium of

India and Africa, which have the hottest climates, is of the poorest quality; while that of Turkey and France, which have the coldest, is the best. In India the average yield of opium per acre is said, by good authority, to be from twenty-five to forty pounds avoirdupois. In the department of Somme, in France, 40,000 acres are cultivated annually with the poppy, and the good opium sells at wholesale for $8 to $10 per pound, according to the quality. At a standard of 10 per cent. of morphia it will sell for $7 to $7 50 per pound. Besides the opium extracted from the capsules of the plants cultivated on this large area of land, the seeds have some years been sold for about $896,000 for the oil which they contained. The average yield of oil from the seeds of capsules which have not been scarified is 25 to 27 per cent., and it is considered better for salad oil than most olive oils sold in the market. Seeds from scarified capsules should not be used for planting, as their vitality has been much weakened by this process, and the plants which they produce are correspondingly feeble. They yield only about two-thirds as much oil as other seeds. The poppy is also cultivated in Germany on a large scale, both for opium and for oil. Its culture commenced only a few years ago, but so great has been its success that the opium produced there has nearly supplanted the use of the foreign article. From Germany it passed over to France, and there are now 60,000 to 70,000 acres under profitable cultivation in the latter country.

EXPERIMENTS.

In Jefferson County, New York, one-fourth of an acre, planted with the poppy, produced twenty-seven pounds of opium in four years, equal to one crop of twenty-seven pounds per acre, which, at $10 per pound, would amount to $270, as the income of one acre of land for one year. Specimens were sent to New York for analysis, and the percentage of morphia was found to be equal to the average of the best imported. The grower thinks it will pay to cultivate the poppy in this country, if the work is conducted with proper skill; and that he can get more money from one acre of land planted with poppy than from three acres with any other crop which he has ever seen. A man of small means, who will cultivate it with skill and perseverance, can make it profitable. A capable boy can cultivate a quarter of an acre easily. It requires no more weeding and hoeing than any garden crop. Good, rich land is required, which should be pulverized and leveled as for onions. He sows in drills as given in our second method, and thins out to six inches between the plants. The young plants which are thinned out make excellent greens, fully equal to the beet or the spinach.

Dr. E. Lewis, of Topeka, Kansas, cultivated the poppy in York County, Pennsylvania, and gives it as his opinion that opium can be profitably produced in the latter State. He makes one incision horizontally around the capsules soon after the petals of the flowers have fallen, and usually performs the operation only once upon the same capsule; but if it is large he would perform it twice at different times.

Mr. W. H. White, of South Windsor, Connecticut, has cultivated the poppy, on a small scale, in the garden. After the petals have fallen he makes five, six, or more slight cuts in the capsules from top to bottom, a little before noon. A few hours after the incisions have been made the opium is scraped off and allowed to stand for a short time, when it is worked into balls. Families in that State sometimes collect it in this way for their own use as a medicine for their children, and find that it answers all the purposes of the opium of the shops. A ball as

large as a small pea is frequently obtained from the heads of a single plant.

The cultivation of the poppy is becoming an important industry in Vermont, especially in Addison County, on Lake Champlain. Mr. Robbins, of Hancock, has cultivated it for some years, and specimens of his opium have yielded 15.75 per cent. of morphia. Two years ago Mr. Monkton, who resides near the village of Middlebury, raised $3,000 worth of opium. Mr. W. C. Wilson, of Monkton Ridge, has been cultivating it for five years, and has derived a handsome profit from the sales. On one farm in East Middlebury there are several acres under cultivation, and the business is gradually extending throughout that part of the State.

Mr. Baudrye, of Nevato, Marin County, California, has just commenced the culture of the poppy in that town. Specimens of opium analyzed yielded 5.75 per cent. of morphia, which, though small, is nearly equal to the average of opium from India. Mr. Baudrye sold his opium in California for $7 per pound. Mr. Guillardon, of Lower Lake, Lake County, has thirteen acres planted with the poppy, which he is cultivating both for opium and oil. A gentleman who is familiar with opium culture in India and Germany thinks the middle and southern portions of California are unsurpassed in soil and climate by any country for the production of opium, and that with a little irrigation two crops might be raised yearly.

THE BEET-SUGAR INDUSTRY.

After a series of preliminary disappointments and failures, such as embarrass almost every improvement, the economic difficulties of the beet-sugar industry seem to have been measurably overcome. Much still remains to be done, but from the results already attained capital finds fair inducements for more extended investment, both in the culture and the manufacture. Three establishments—one at Chatsworth, Illinois, one at Alvarado, California, and the third in Sauk County, Wisconsin—are manufacturing a good quality of sugar with sufficient success to render future efforts promising. Other manufacturing enterprises have been projected, while in many places the experimental culture of the beet has been inaugurated with a view to manufacture. At Chatsworth, Illinois, in 1864, Messrs. Gennert purchased two thousand acres of land and erected a manufactory. They subsequently sold out to an association called "The Germania Sugar-Beet Company." This establishment has motive power and machinery sufficient to work up fifty tons of beets per day. In 1866 they raised four thousand tons of sugar-beets on four hundred acres, at an estimated cost of $4 per ton. Since that time, however, the cost of production is said to have been reduced to $2 70 per ton, through the introduction of machinery. The crop of 1870 covered only three hundred and thirty acres, of which one hundred and thirty proved an entire failure through the drought, leaving but two hundred productive acres. The seed used is known as the "White Imperial," and was imported specially for this enterprise. In order to decrease the size of the beets, and thus obtain a larger percentage of sugar, the seed is sown quite thickly, and the roots in ordinary seasons do not exceed one and a half or two pounds each. By allowing the beets to grow large the crops may be raised to

an average of twenty-five tons per acre, but the decline of saccharine properties counterbalances the increase in quantity. The average crop of the two hundred productive acres in 1870 was about nine tons, but the beets were much richer in sugar than in wet seasons. Much labor is saved in harvesting the beets, by a simple contrivance admitting the application of horse-power. The roots are preserved in pits, and protected from the frost until the manufacturing season approaches. Hand labor in cultivation is almost entirely confined to thinning out the beets. The full success of the enterprise, however, can be secured only by the extension of sugar-beet culture among the farmers, to whom it recommends itself by several economic advantages. Its beneficial influence upon the soil, and the cheap stock-feed which it furnishes, will doubtless attract the attention of the meat producers of Illinois.

The sugar already produced at Chatsworth is highly recommended. The first yield was placed in the Chicago market without brand, and was pronounced by experts to be equal to A 1 New York sugar, readily bringing the price of that article. From the beginning, a fair article of sugar was made by this establishment, but in the earlier efforts the expense of the process overbalanced the market value of the product. This has been attributed to injudicious management of the enterprise in its earlier stages, and to a too rigid adherence to the ideas and formulæ of European industry. The present superintendent, Mr. Jonathan Perriam, is a native American and a Western farmer. He seems to have overcome, to a great extent, the practical obstacles in the way of the economic success of the enterprise. In a letter to this Department, dated January 2, 1871, he states: "The continued lack of water puts us to the most serious disadvantages in the manufacture." He further complains of the necessity of depending "upon foreign laborers who do not understand our language, nor appreciate the necessity of economizing." He hopes by the extension of machinery to overcome this latter difficulty, and expresses his decided opinion that "beet-sugar, upon favorable soils, with plenty of good water for manufacturing, will be a success, in a business point of view, if economically managed." It is proposed to remove this establishment to a location having a soil better adapted to the growth of the sugar-beet, and one with a more abundant supply of water.

Great confidence is felt upon the Pacific coast in the final success of the beet-sugar industry in that region. Ten years ago Mr. George Gordon, since deceased, exhibited at the fair of the Mechanics' Institute, in San Francisco, a superior article of beet-sugar. Still later, Mr. Claus Sprechman, of the California sugar refinery, imported beet seeds from Germany and France, and made a liberal distribution of them among the farmers of California, stipulating for a specific quantity of beets in return, with information as to locality, modes of culture, &c. With these beets critical and scientific experiments were made by machinery. It was found that alkaline elements in the soil deteriorated the practical value of the roots. This result so discouraged Mr. Sprechman that he abandoned the enterprise. Mr. Gordon proposed to resuscitate it, but prior to commencing operations he associated with him Mr. Sprechman and a Mr. Wentworth, with whom he visited Europe to observe the beet culture and sugar manufacture on that continent. They never renewed their efforts in this country.

In the spring of 1870 Messrs. Bonesteel, Otto & Co., who had been engaged in the beet-sugar enterprise at Fond du Lac, Wisconsin, were induced to remove to California, where they organized the Alvarado Beet-Sugar Manufactory, at Alvarado, in Alameda County, under the

auspices of a company of capitalists, who had invested $250,000 in the enterprise. The initial results of this movement were so flattering as to give rise to some extravagant anticipations. One enthusiastic journalist predicted that in five years California would be a sugar-exporting State. The Alvarado company now occupy a three-story building, 150 feet long by 50 feet wide, with a boiler-house 59 feet by 50, and a bone-coal house 75 feet by 40. The machinery is sufficient to work up fifty tons of beets per day. The motive power is furnished by four tubular steam-boilers, each 16 feet long and 54 inches in diameter. These drive the three steam-engines, of which two are 14 by 30, (first-class finish,) and one 16 by 12. The apparatus embraces vacuum pans, saturation pans, air-pumps, filters, filter-pumps, beet-grater, beet-washing machine, beet-breaking machine, tanks for elevating sirup and sugar from one floor to another, and a number of sheet-iron tanks for various purposes. An abundant supply of shafting, pulleys, pipes, pumps, and other fittings incidental to a complete sugar manufactory and refinery have been provided, enabling the company to transform the beets into fine granulated sugar within twenty-four hours after their reception.

Through delay in receiving that portion of the machinery which had been ordered from Germany, the manufactory did not commence operations until Tuesday, November 15, 1870. On the following Thursday many friends of the enterprise assembled to witness the first turn-out of sugar. Anxiety and unbelief were the prevailing expression, both of voice and of countenance, as, at 10 o'clock a. m., the contents of one of the large pans were emptied into one of the sugar centrifugals and set in revolution. In less than three minutes the white sugar began to crystallize, doubt gave way to enthusiasm, and all present pronounced the sugar superior to cane sugar. Some allowance, however, must be made for the excitement of the occasion.

In this establishment the beets are first thoroughly washed in a cylinder composed of slats, one end of which is depressed in a tank of water. By revolution upon its axis, the beets, rubbing constantly upon each other in the water, are thoroughly cleansed by the time they reach the lower end. They are then elevated to the grater, a formidable piece of machinery upon the third floor, furnished with a rasp which revolves 1,500 times per minute. Against this rasp the bright, clean roots are pressed, and in a very short time are reduced to a fine watery pulp, which is then drawn off into the centrifugals below. Of these there are ten, each revolving 1,200 times per minute, and thoroughly separating, by their rapid movement, the juice from the pulp. The former passes through large troughs into defecating pans; the latter is removed through a spout into the dried-pulp room below. In the defecating pans the impurities of the juice are absorbed by a preparation of lime; thence it runs into two close upright boilers, called by the French *montejus*. These are located on the lower floor, and by steam pressure elevate the juice to large filter-presses in the second story. It then passes into the saturating pans, where the lime, previously absorbed in the clarifying process, is eliminated by an infusion of carbonic acid gas. It is then filtered through animal charcoal, whence it passes into two evaporating pans, and is subjected to a boiling heat till it reaches the proper consistency. It is then drawn off into iron tanks to cool and crystallize; after which it is placed in an open upright cylinder, in which an iron axle with projecting arms slowly revolves, mingling the entire mass into a sort of heavy molasses. The sirup is then expelled by a rapid revolution in four sugar centrifugals, the residuum being "first-class" sugar, ready for market. The ejected sirup is again placed in the cen-

trifugal and "second-class" sugar is produced. The process is repeated for the third and sometimes for the fourth time.

The heavy-lifting operations of this establishment are all done by steam raised from the screenings of the Monte Diable coal mines, about nine tons of which are consumed daily. The working force embraces about thirty white men, and as many Chinese. The greatest economy of material is strictly observed in all parts of the process. The scum of the defecating pans is removed, and subjected to a separate filtering process, when its residuum is allowed to mingle with the defecated juice. The machinery, so far, has worked remarkably well.

The success of this enterprise being greatly dependent upon an abundant supply of raw material, the company have engaged extensively in the culture of the beet. About eight hundred acres of their land will be planted in beets during the season of 1871, for which a full supply of seed has been imported from Germany. This arrangement is provisional, and will be superseded when a sufficient number of farmers can be found competent and willing to engage in the culture. Allowing an average of twenty tons of beets per acre, and an average yield of 8 per cent. of sugar, the company will have a sufficient supply of raw material to enable them to operate at least three hundred days in the year, and nearly two and a half millions of pounds of sugar to produce.

This union of diverse processes of production, embracing both raw material and finished product, is not in accordance with that principle of division of labor which has enabled modern industry to achieve its splendid results. It is to be hoped that the agricultural part of the enterprise will soon be assumed by agricultural men. The Mitchell nursery, near San José, has produced fifty tons of good beets per acre. The present price of roots at the Alvarado factory is $3 50 per ton. A product of twenty tons will realize $70 per acre.

The Alvarado Company has hitherto confined its attention exclusively to the German beet. Experiments will be made with other seeds to discover the variety best adapted to the soil.

An establishment has been in operation at Sacramento, and during the past year a considerable quantity of sugar has been produced, but expenses have not been realized, and an assessment of $2 per share has been made upon the stockholders. This company has been paying $5 per ton for beets; $1 50 more than was paid by the Alvarado Company. The difficulties that embarrass the enterprise seem to be in the beet culture of the neighborhood, and in the low percentage of sugar secured. The experience of the proprietors leads them to conclusions very different from those of European beet-growers. The latter obtain the maximum of saccharine matter in the latest growth prior to autumnal frosts. The beets grown here lost half their sugar during the last six weeks of their growth. Perhaps in the adjustment of this difficulty the beet culture here may find its final opening to success.

Under date of December 29, 1870, Tyler Beach, secretary of the Santa Clara Valley Agricultural Society, informs this Department that, under the auspices of that society, a beet-sugar company has been formed, with a capital of $200,000 for the manufacture of beet sugar at San José, California. He solicits from this Department a variety of beet seeds, in order to test by actual experiment the adaptability of each to the soil and climate of that locality. In answer to this request four varieties of seeds were sent. This enterprise is prosecuted by intelligent and careful business men, who, with the experience of the Alvarado Company before them, entertain strong hopes of success.

Sugar-beet culture has been commenced in Colorado with very promising initial results. Reports of enormous yields are received, two cultivators having secured over seventy tons per acre. Farmers were sanguine as to their ability to raise an average of fifty tons. Their quality is now being tested at Chatsworth, Illinois. Efforts are being made to establish a manufactory in Colorado.

The value of success in industry may be partly estimated from our enormous importation of foreign sugar. During the fiscal year ending June 30, 1870, we imported 1,160,460,114 pounds of brown sugar, 151,520 pounds of refined sugar, 36,161,935 pounds of melado and sirup of sugar-cane, 55,820 pounds of candy and confectionery, and 56,373,537 gallons of molasses. The total declared value of these imports was $69,827,884. Our domestic sugar-cane, beet, maple, and sorghum did not amount to one-eighth of this aggregate. Europe, from the expansion of her beet-sugar production, now supplies one-half of her home demand, and the industry is extending into England upon a scale which promises to rival that of the continent. We see no reason to doubt that we, with our abundant natural resources, may be able to do fully as well as Europe. Estimates by French statisticians prior to the insurrection in Cuba place the world's aggregate sugar production at 2,300,000 tons, one-third of the whole amount being assigned to Cuba. The industry of the cane-producing countries of the world, from which the great mass of our import is derived, is mostly in a rudimentary or in a disorganized condition. Slave labor still exists in Brazil and the Spanish West Indies, while the emancipated labor of other regions as yet works at a disadvantage, not having been systematized or adapted to the conditions of a progressive civilization. The reorganization of this free labor has been in progress for many years, yet it is not so far advanced as in our Southern States after an interval of only five years of peace; nor does it present any prospect of a more rapid reconstruction in the future. Hence, though enjoying the exuberant natural resources of a tropical soil and climate, these foreign sugar industries will work at an essential disadvantage with our own. The insurrection in Cuba has desolated the finest portions of the island, and the financial condition of the sugar interests is critical. Of 1,800 plantations it is reported that scarcely 1 per cent. is free from mortgages, and that operations are prosecuted at such a disadvantage as to return not over 4 per cent. on the capital, while money loans cost 9 per cent. Into this breach, then, the beet-sugar industry of the United States should at once be thrown, and the best use be made of its excellent opportunity.

The value of the beet-sugar manufacture, as an aid to stock fattening and to intensive culture, has frequently been mentioned. Both leaves and pulp furnish valuable food for stock. Dr. Voelcker, in the Journal of the Royal Agricultural Society of England, gives the following analysis of beet-root pulp, from Mr. Duncan's experimental crops at Lavenham:

Water	70.11
Flesh-forming substances, (containing nitrogen)	2.25
Sugar	3.39
Mucilage	1.93
Digestible vegetable fiber	15.13
Wood fiber	5.32
Ash	1.87
	100.00

The best root contains $15\frac{1}{2}$ per cent. of solid matter, while, from the

above analysis, it appears that the pulp yields nearly 30 per cent. This is accounted for by the fact that in the process of manufacture the residuary product has lost a large proportion of its water. The pulp obtained from 20 tons of beets would amount to about 72 cwt. yielding about 21.6 cwt. of solid matter. According to the same authority mangel-wurzel contains but 11 per cent. of solid matter, and a crop of 20 tons would yield but 44 cwt. Hence the pulp alone of an acre of sugar beets would be nearly equivalent in solid material to a half crop or 10 tons of mangel-wurzel. Dr. Voelcker estimates that in availibility for stock feeding a ton of pulp equals 1½ tons of sugar beets, or 2 tons of common beets. Another English agricultural writer estimates the value of 20 tons of sugar beet, as stock feed, as equal to that of 30 tons of mangolds. The agricultural branch of the sugar industry has many elements of prospective profit. The skill of our manufacturers will keep pace with our agricultural production in simplifying, cheapening, and extending the processes of extraction. From all present indications no reason appears why our beet-sugar production should not at least equal that of Europe, if not greatly surpass it.

THE BEET-SUGAR PROGRESS IN EUROPE.

Professor Church, of the Royal Agricultural College of England, at a late session of the Cirencester Chamber of Agriculture, presented some statistics of the beet-sugar interest in Europe. The entire yield of the continent in 1869 was over 611,000 tons from 1,800 sugar manufactories. The sugar beet is cultivated from the Atlantic to the Caspian, and nearly as far north as the Arctic Circle. One variety sprouts at 44° F., and will bear, without injury, a brief exposure to the temperature of 32°. The average yield per acre varies in different countries. In Austria it is ten tons; in France, twelve; and in Prussia, fourteen. In some Departments of France, however, the average is very much greater. An agriculturist in the Department of the Seine reports an average of thirty-eight tons on his own farm and upon several neighboring farms. A German agriculturist, under an improved mode of culture, claims an equal average. Experiments in Ireland indicate average crops of sixteen to forty tons per acre, with a percentage of saccharine matter as high as sixteen. It is probable that England and Ireland are capable of growing large crops of the sugar beet with a high percentage of saccharine matter. In France, during 1869, the entire product of beet-sugar manufacture was about 300,000 tons, which, at $125 per ton, or 6¼ cents per pound, amounted to $37,500,000. To this add about $2,500,000 for molasses or rough treacle, available for spirit distillation, and the saccharine product of the country amounts to $40,000,000 per annum. The number of manufactories had increased from twenty-nine in 1827 to three hundred and thirty-six in 1860, and to six hundred in 1869, besides five hundred spirit distilleries.

Another gentleman stated that in the neighborhood of Douay, a great sugar market of France, a ton of beets would yield twenty gallons of spirit, and the pulp would pay for the manufacture and the interest on the capital. Some land yielded thirty tons per acre, and the beet had been grown for fifteen years in succession. The Silesian white beet was preferred to the red beet, yielding a greater percentage of sugar. A sugar manufactory and distillery, worth about £20,000, would work up 10,000 tons of beets per annum. Under one system, however, a distillery might be erected at a cost not exceeding £1,600. In England this industry produces twenty tons of beets per acre, and four hundred gallons of spirits, which at 10*s.* per gallon would secure a revenue of £200,

or $1,000 per acre to the government. The presence of a sugar manufactory or distillery always made money plenty in the neighborhood, though the French agriculturists are generally a poor class.

In regard to the development of this industry in England, Professor Church states his belief that all former failures in raising the beet were the result of mistakes in the process of culture, and were in nowise due to any lack of adaptation either of climate or soil. The culture will ultimately be as successful as on the continent. English farmers will yet grow from twenty to thirty tons per acre, getting 16*s.* per ton, and receiving back pulp for stock-feeding at 13*s.* per ton. The crude liquor, embracing four-fifths of the potash abstracted from the soil, will probably be given to the farmer for a fertilizer, on condition of merely carting it away.

The Professor contends that thorough culture is essential to success. It would be necessary to experiment fully and accurately to determine which variety of the beet is best suited to the soil and climate. The soil must be finely pulverized and free from stones. The tendency to too great a production of leaf should be restrained, as this diminishes the percentage of sugar. A good root will sink in water. The growing roots should be so earthed up that their color will not be distinguishable, for the reason that when raised above the soil there is great resistance to the formation of the tap root; the plant will not develop itself regularly, and the result is a root forked and contracted and poor in sugar. The top layer of an exposed root will yield only 5 per cent. of sugar, the next layer 6½, and so on to 16 or 18 per cent. in a beet yielding but 10 per cent.

He holds that a mixed soil, not too easily dried, is best for the beet. The alkaline matter should not be in large proportion for sugar, but for spirit manufacture this circumstance is not so important. Deep plowing is a requisite to success, and even double plowing is desirable. Seed should be sown by the middle of April. A fair average yield would be twenty tons of beets and fifteen tons of leaves. He stated that these twenty tons of beets would remove from an acre of land one hundred and eighty pounds of potash, fifty pounds of phosphoric acid, thirty-two pounds of magnesia, eighteen pounds of sulphuric acid, and sixty-seven pounds of nitrogen. Thirty-five bushels of wheat, weighing sixty-two pounds each, would take from an acre of land only twelve pounds of potash and eighteen pounds of phosphoric acid, or but thirty pounds of solid earthy matter; and that, while twenty tons of beets take away three hundred and forty-seven pounds of solid matter and nitrogen, their leaves extract nearly five hundred pounds more. Of these, potash and phosphoric acid are the most valuable ingredients of the soil, and their waste should be supplied by manuring with the refuse matter of the sugar manufacture. The waste liquor of distillation alone contains three-fourths of the abstracted potash. The manure of animals fed upon the pulp and the leaves would nearly embody the remaining fourth.

Of beets sown on the grounds of the agricultural college, the manure having been applied for four years, the following percentages of sugar were found in harvestings at different periods, viz: August 10, 8.70 per cent.; August 24, 9.20; September 7, 9.77; September 21, 10.48; October 5, 12. It was said that another fortnight's growth would have raised the percentage to 13 or 14. The formation of sugar may be tested by the growth of the leaves, undue vigor in the latter meaning loss in the former. An easy test is to take up a few roots and rasp them with a bread grater, and find the specific gravity of the juice. If the bulb

marked 7 floats in it, it is good; if not, it is poor. A good root generally turns to a pink color when cut with a knife and exposed to the air; a poor root blackens. The pulp is an excellent fodder for dairy cows, if mixed with other food. A ton of pulp is equal to one and a half tons of beets. It is important to the success of the culture that the chemical constituents drawn from the soil be returned in the form of manure.

Mr. Caird, in the London Times, gives an account of the successful experiment in beet sugar manufacture by Mr. Duncan, at Lavenham. The year 1870 was the third year of the Lavenham factory and of the successful growth of the sugar-beet in England on any considerable scale. It is now converting four hundred tons of roots per week into crystallized sugar. The chemical analyses of the roots in the previous years were satisfactory, but the chemical and mechanical processes for extracting the sugar were defective. Perseverance and intelligence have finally triumphed over difficulties, and the sugar industry is now successfully inaugurated in England. Mr. Duncan is satisfied that Suffolk County is as well adapted to the beet culture as Northern France. The total value of the sirup produced in 1869 was £960. Expenditures of all kinds, including excise duties, amounted to £660, leaving a profit of £300, besides the pulp and the refuse products of manufacture. In 1870 the roots improved in their percentage of sugar; but, on the other hand, sugar is very cheap. The return of the pulp and refuse products to the soil prevents its impoverishment. The establishment gives employment to the entire surplus labor of the parish, at good wages, during the slack season. Capital is profitably employed, trade is stimulated, and the supply of sugar augmented.

Mr. Campbell, of Buscot Park, Berkshire, is conducting a similar experimental beet culture, to be devoted to the manufacture of sugar, or to the distillation of spirit, as may be most profitable. His crop has realized all his expectations, showing that Berkshire, as well as Suffolk County, is well adapted to the beet culture. The sugar-beet, even used solely as stock feed, is superior to the mangold, a ton of the former being equal to a ton and a half of the latter, according to Dr. Voelcker's analysis.

Independent, then, of the sugar and spirit manufacture, the sugar-beet promises an extensive introduction into English agriculture. There are now about 200,000 acres of mangolds grown in the counties between the Marsh and the English Channel. One-fourth of this area devoted to sugar-beet will secure 60,000 tons of sugar per annum, about one-tenth of the present sugar consumption of the United Kingdom.

GRASSES OF THE PLAINS AND EASTERN SLOPE OF THE ROCKY MOUNTAINS.

The region of country lying west of the Missouri River, between the parallels of 35° and 45° north latitude, and known as the high plain region of the United States, extends to and embraces the eastern water shed of the Rocky Mountains between those parallels, including the States and Territories of Nebraska, Kansas, Colorado, New Mexico, and the Indian Territory. In consequence of the rapid settlement of this extensive tract, occasioned by the facilities which the several new railroad lines afford the emigrant for reaching this heretofore almost inaccessible domain with supplies and implements of husbandry, it has be-

come important to the settler that a scientific account of that portion of the indigenous flora of the region which is to furnish the food for his domestic animals, for a few years at least, should be given. It is proposed to exhibit the general character of its gramineous flora as now existing, and to suggest varieties most likely to prove profitable in cultivation.

The following is a catalogue of the species embraced in the territory under consideration, with the range to the eastward of those which extend across the Missouri River:

Leersia Virginica, Willd. Not a prairie species. East to the Atlantic.
Leersia oryzoides, Swartz. A wet ground or bog plant; worthless. East to the Atlantic.
Leersia lenticularis, Michx. Low rich soils; worthless. Southeastward to Virginia.
Zizania aquatica, Lin. The wild rice of the northwest. Northeastward.
Alopecurus pratensis, Lin. Variety from Europe. In pastures eastward.
Alopecurus geniculatus, Michx. Ponds—wet and dry places. Eastward.
Phleum Alpinum, Lin. Mountain stations. High mountains in New England
Vilfa aspera, Beauv. Arid soils. Southeastward.
Vilfa vaginæflora, Torr. Various localities; worthless. Southeastward.
Vilfa tricholepis, Torr. Mountains.
Vilfa depauperata, Torr. Plains.
Vilfa cuspidata, Torr. Plains.
Sporobolus asperifolius, Nees. Mountain valleys.
Sporobolus ramulosus, H. B. K. Mountain valleys.
Sporobolus aroides, Torr. Mountain valleys.
Sporobolus cryptandrus, Gray. Plains. East to Atlantic.
Sporobolus heterolepis, Gray. Plains. East to Connecticut.
Agrostis varians, Trin. High mountains.
Agrostis rupestris, All. High mountains.
Agrostis scabra, Willd. Mountains and plains. East to Atlantic.
Vaseya comata, Thurb. Mountains.
Cinna arundinacea, L. East to New England.
Muhlenbergia pungens, Thurb. Plains.
Muhlenbergia gracillima, Torr. Plains.
Muhlenbergia gracilis, Trin. Plains.
Muhlenbergia Mexicana, Trin. Mountains and streams; on the plains. East to the Atlantic.
Muhlenbergia sylvatica, Torr, & Gray. Mountains and streams to the plains. East to the Atlantic.
Eriocoma cuspidata, Nutt. Sandy plains.
Calamagrostis Canadensis, Beauv. Swamps and wet lands. Northeastward.
Calamagrostis sylvatica, D. C. Mountains.
Calamagrostis stricta, Trin. Mountains.
Calamagrostis gigantea, Nutt. Plains.
Calamagrostis longifolia, Hook. Plains. Northeast to Michigan.
Oryzopsis micrantha, Thurb. Mountains.
Oryzopsis Canadensis, Torr. Mountains. Northeast to New England.
Oryzopsis asperifolia, Michx. Mountains. Northeast to New England.
Stipa viridula, Trin. Mountains and plains.
Stipa spartea, Trin. Plains. East to Illinois and Michigan.
Stipa capillata, Lin.
Aristida purpurea, Nutt. Mountains and plains.
Aristida dichotoma, Michx. Plains. East to the Atlantic.
Aristida gracilis, Ell. Plains. East to the Atlantic.
Aristida oligantha, Michx. Plains. Southeastward.
Aristida purpurascens, Poir. Plains and mountains. Eastward to the Atlantic.
Spartina cynosuroides, Willd. Plains—wet lands. East to the Atlantic.
Spartina gracilis, Trin. Plains.
Bouteloua oligostachya, Torr. Mountains and plains. Most valuable of the "grama grasses."
Bouteloua curtipendula, Gray. Mountains and plains. East to New York.
Bouteloua hirsuta, Lagasca. Plains. East to Illinois.
Bouteloua eriopoda, Torr. Mountains, &c., of New Mexico. The small "grama grass."
Gymnopogon racemosas, Beauv. Indian Territory. Southeastward to the Atlantic.
Pappophorum boreale, Ledeb. Plains. New Mexico.
Leptochloa fascicularis, Gray. Plains. East to Illinois. On the Atlantic.
Leptochloa mucronata, Kunth. Plains. Indian Territory. East to Illinois and Virginia.

Tricuspis mutica, Torr. New Mexico.
Tricuspis pulchella, Torr. Mountains.
Tricuspis purpurea, Gray. Plains. East to the Atlantic.
Graphephorum flexuosum, Thurb. Plains.
Diarrhena Americana, Beauv. Timber belts—plains. East to Ohio.
Kœleria cristata, Pers. Mountains and plains. East to the Atlantic.
Eatonia Pennsylvanica, Gray. Mountains. East to the Atlantic.
Eatonia obtusata, Gray. Mountains. East to Pennsylvania.
Glyceria aquatica, Smith. Mountains. Northeastward.
Glyceria pauciflora, Torr. High mountains.
Glyceria airoides, Thurb. Mountain valleys.
Glyceria nervata, Trin. Wet soils and swamps. East to the Atlantic.
Brizopyrum spicatum, Beauv. Plains. East to the Atlantic.
Poa annua, Lin. Plains and mountains. East to the Atlantic.
Poa Alpina, Lin. High mountains. Northeastward to the Atlantic.
Poa memoralis, Lin. Mountains.
Poa Andina, Nutt. Mountains.
Poa arctica, R. Br. Mountains.
Poa serotina, Ehrh. Mountains. Northeastward.
Poa crocata, Michx. Mountains.
Poa pratensis, Lin. Mountains. The European variety. Eastward to the Atlantic.
Eragrostis Purshii, Schrad. Plains. Southeast to Virginia.
Eragrostis tenuis, Gray. Plains. East to Illinois.
Eragrostis oxylepis, Torr. Plains.
Eragrostis reptans, Nees. Wet places. East to the Atlantic.
Eragrostis megastachya, Link. Plains, &c. East to the Atlantic.
Eragrostis pectinacea, Gray. Plains, &c. East to Massachusetts.
Eragrostis capillaris, Nees. Plains. Southeastward.
Festuca orina, Lin. Mountains and plains. Northeastward to New England.
Festuca pauciflora, Thurb. Mountains.
Festuca rubra, Lin. Mountains and plains.
Festuca scabrella, Torr. Mountains.
Festuca tenella, Willd. Mountains and plains. Eastward to the Atlantic.
Festuca macrostachya, Torr. Mountains, &c. New Mexico.
Festuca nutans, Willd. Timber belts. Eastward to the Atlantic.
Bromus Kalmii, Gray. Mountains and plains. Northeastward.
Bromus ciliatus, Lin. Mountains and plains. Eastward to the Atlantic.
Ceratochloa grandiflora, Hook. Mountains.
Sesleria dactyloides, Nutt.
Uniola stricta, Torr.
Uniola latifolia, Michx. Timber belts. East to Pennsylvania.
Phragmites communis, Trin. Ponds, &c. East to the Atlantic.
Lepturus paniculatus, Nutt. Plains. East to Illinois.
Buchloe dactyloides, Engelm. Plains. The buffalo grass of the region.
Monroa squarrosa, Torr. Plains.
Triticum repens, Lin. Plains and mountains. Naturalized eastward.
Triticum caninum, Lin. Plains and mountains. Naturalized eastward.
Triticum ægilopoides, Turcz. Mountains and plains.
Hordeum jubatum, Ait. Plains and mountains. East to the Atlantic.
Hordeum pusillum, Nutt. Plains. East to Ohio.
Elymus Canadensis, Lin. Plains and mountains. East to the Atlantic.
Elymus Virginicus, Lin. Plains and mountains. East to the Atlantic.
Elymus Sibiricus, Lin. Mountains and plains. Northeast to Minnesota.
Elymus striatus, Willd. Timber belts. East to the Atlantic.
Elymus condensatus, Presl. Mountains.
Elymus triticoides, Nutt. Mountains.
Sitanion elymoides, Raf. Mountains.
Gymnostichum hystrix, Schreb. Timber belts. East to the Atlantic.
Danthonia sericea, Nutt. Mountains. East to Massachusetts.
Danthonia spicata, Beauv. Timber belts. East to the Atlantic.
Avena striata, Michx. Mountains. East to New England.
Aira cæspitosa, Lin. Mountains. Northeastward.
Hierochloa borealis, Roem. & Schult. Mountains. Northeast to the Atlantic.
Phalaris arundinacea, Lin. Wet localities. Northeastward.
Paspalum setaceum, Michx. Plains. East to the Atlantic.
Beckmannia erucæformis, Host. Mountain ponds.
Chloris verticillata, Nutt. Plains south.
Chloris alba, Presl. Plains.
Panicum clandestinum, Lin. Timber belts. East to the Atlantic.
Panicum capillare, Lin. Various localities. The whole country.

Panicum crus-galli, Lin. Various localities. The whole country.
Panicum depauperatum, Muhl. Plains. East to the Atlantic.
Panicum dichotomum, Lin. Mountains and plains. East to the Atlantic.
Panicum filiforme, Lin. Plains. East to the Atlantic.
Panicum latifolium, Lin. Timber belts and mountains. East to the Atlantic.
Panicum obtusum, H. B. K. Plains.
Panicum pauciflorum, Ell. Mountains and plains. East to the Atlantic.
Panicum sanguinale, Lin. Naturalized. Whole country.
Panicum virgatum, Lin. Plains and mountains. East to the Atlantic.
Panicum xanthophysum, Lin. Plains northward. Northeastward.
Setaria glauca, Beauv. Introduced. Widely spread in the Eastern States; introduced.
Setaria viridis, Beauv. Introduced. East to the Atlantic; introduced.
Cenchrus tribuloides, Lin. Sandy plains. East to the Atlantic.
Tripsacum dactyloides, Lin. Plains, moist situations. Southeastward to the Atlantic.
Andropogon furcatus, Muhl. Plains and mountains. East to the Atlantic.
Andropogon scoparius, Michx. Plains and mountains. East to the Atlantic.
Andropogon argenteus, Ell. Plains. Type on the Atlantic southeastward.
Andropogon glaucus, Torr. Plains.
Sorghum nutans, Gray. Plains and mountains. East to the Atlantic.

Of the fifty-seven genera and one hundred and forty-three species in the foregoing catalogue, ninety-one extend across the Missouri River, leaving fifty-two species belonging to the plain and mountain region proper. A few strictly plains grasses cross the Missouri River, as *Lepturus paniculatus*, *Elymus Sibiricus*, *Calamagrostis longifolia*, *Stipa spartea*, *Bouteloua hirsuta*, *Triticum caninum*, and *Triticum repens*. The remaining eighty-four species could not be considered as belonging more to this region than to the States east. The relative value of these various species as forage grasses differs very widely, a few of them being entirely worthless, and many of them almost valueless as compared with others. The largest number of the species could be dispensed with without manifest disadvantage to the grazing interests of the country. The relative value of the twelve most important species is exhibited in the following table of per centum estimates, one hundred representing the aggregate value of the twelve:

Species.	Missouri River region.	Rocky Mountain region.
	Per cent.	*Per cent.*
Andropogon furcatus	40	16
Andropogon scoparius	20	10
Sorghum nutans	20	12
Sporobolus heterolepis	12	1
Buchloe dactyloides	5	5
Bouteloua oligostachya	0	10
Spartina cynosuroides	2	2
Festuca ovina	0	20
Festuca macrostachya	0	5
Bromus Kalmii	0	8
Poa serotina	0	8
Stipa viridula	0	5

These estimates can only be approximate, of course, but they are believed to be so nearly correct that, as a comparative exhibit of the relative value of the species now comprising the great forage resources of the country, their importance will not be overlooked. The flesh and fat producing qualities of these several species have not yet been suf-

ficiently tested to warrant comparative estimates of their relative values in this respect.

Andropogon furcatus, *Andropogon scoparius*, and *Sorghum nutans*, by their abundance in all the eastern portions of the district, are the leading species, and at present comprise at least three-fourths of the grazing resources of that portion of the country. Next in importance follows *Sporobolus heterolepis*. This species is peculiarly palatable to cattle, and they are seen roving over rich pasture of other species in search of it. This is also said to be the winter forage species of Kansas, where it abounds, affording the rich winter pasturage of the farmers and herders of that State. It flourishes chiefly on the moister portions of the plains, and many local areas are almost exclusively occupied by it.

In the following description of species, descriptive terms only that may be readily understood by all will be used, and from which it is believed the identification will not be difficult to those who do not understand botanical terms:

Andropogon furcatus, Muhl.—This species, the most abundant over large areas, is distinguished only by its spikes of flowers and fruit from its near relatives, *Andropogon scoparius* and *Sorghum nutans*, with which it often grows. It grows nearly twice as tall as *A. scoparius*, with spikes of flowers longer, and rigid, and two to five together, terminal, and on short branches from the axils of the upper leaves. The spikes are purplish generally, but often entirely destitute of color. It does not fruit every year nor in all situations. A very favorable season of moisture is required to cause it to fruit abundantly. It is one of the principal hay grasses of the country, and is abundantly cut and cured for winter use.

Andropogon scoparius, Michx.—A much smaller plant than the foregoing, and much less abundant, yet apparently quite as valuable as feed for stock. It is known by its numerous slender branches from the axils of all its upper leaves, having its spikes of flowers single and scattered along the branches, very slender and thinly silky, hairy, and often purplish as the preceding species, and frequently growing with it, and difficult to distinguish from it when not in fruit. This is also one of the hay grasses, and is esteemed of equal value with the foregoing for winter feed. It is singular that these two most valuable western grasses should have been considered "remarkably worthless grasses" by the learned Dr. Darlington, less than twenty years ago.

Sorghum nutans, Gray.—This noble prairie grass is at once known when in flower by its single terminal panicle of sorghum-like spikelets, drooping in mature fruit, shining, with brownish or russet hairs. This plant has often a peculiar glaucous hue, forming a striking contrast when growing with the form destitute of the glaucous bloom. In many localities it is scarcely less abundant than *Andropogon furcatus*, and constitutes a large portion of the prairie hay. Like the two previously described, it fruits only in favorable seasons, and the growth of foliage is also much diminished by dry summers. The hay from these three species is considered best when cut just before killing frosts, in early autumn.

Sporobolus heterolepis, Gray.—This species may be identified from its long, slender leaves, growing abundantly from the base of the plant, gracefully curling, and frequently resting their tips on the ground; from its tendency to grow branches or stools, and, when in fruit, from its small panicle of sharp-pointed spikelets and its round seeds. These, when bruised, emit a strong, heavy odor, which has been compared to that of *Eragrostis megastachya* when crushed in the hands; but to most olfactories it is much less offensive, and to some not at all disagreeable. It

attains to the average height of about two and one-half feet in fruit, but in dry seasons large tracts almost exclusively composed of this species are without a single fruiting plant. It is sometimes cut for hay, in the absence of the more productive species, and makes an article of first quality.

Buchloe dactyloides, Engelmann.—This is the noted buffalo grass of the region, and may be recognized at once, and be distinguished from all other species, by its low, dense, tufted growth; also by its stolons, from which it spreads rapidly. It never attains to the height of over two or three inches, except with its male flower stalks, which sometimes reach two or three inches above the leaf growth. These have at their summit a few flat spikes of male flowers only. The female flowers are clustered down close to the earth, and nearly covered with the tufted leaves. Male and female flowers are borne by the same plants, not by different plants, as was at one time believed. It grows most abundantly in the central region of the plains, and affords nutritious but rather scanty grazing for domestic animals; yet its value as a winter forage plant is not to be overlooked, as its stolons remain green during the winter months, and, combined with the dead leaves, afford to closely-grazing animals a reasonably good living. In Southern Kansas the plant reaches its eastern limits, about one hundred miles west of Fort Scott. There it first appears in small distinctly outlined patches a few feet in diameter, and in narrow strips or lines at the base of low elevations on the large prairies. We were puzzled to understand how this humble grass was holding its place here in the midst of strong, tall, growing competitors, *Andropogon* and *Sorghum* surrounding it closely, but not venturing on an inch of its territory; but we soon succeeded in discovering that the phenomenon resulted from local soil conditions. At the depth of half an inch below the surface of these areas, the soil, for an inch or more downward, is closely compacted and hardened, so as to prevent the roots of plants from penetrating through it. These areas, being thus unfitted for the growth of deep-rooting plants, had become open for settlement by this humble species, which requires only a shallow soil to sustain it. This hardened condition of soil at the base of these low elevations is evidently from the agency of alkali, or some related mineral substance filtering through the soil and cropping out at these places. Not having tested the conditions under which the plant exists in the heart of the plains, the center of its home, we are unable to say whether similar phenomena attend it there; but that an alkaline saturated or tinctured soil is essential to its growth has been disproved by the cultivation of the plant east of the Mississippi, where it flourishes finely, but is unable to compete with its intruding neighbors, and is soon overrun and destroyed. As an instance showing its tenacity of life, we record the fact of its having withstood the treading of the animals in a farmer's feed-lot where every other green thing had been destroyed. Whether it can be turned to any profitable account in the agriculture of the country remains for future experiment to determine.

Monroa squarrosa, Torr.—This comparatively worthless species somewhat resembles the buffalo grass in habit and mode of growth, and might be taken for it by those unacquainted with the latter species, the fascicled and tufted leaves of its prostrate branches resembling the stolons of Buchloe. The plant is an annual, with rigid and rather large foliage, and bears its fruit almost entirely concealed in the sheaths of its numerous leaves. It is rather common in the mountain district and on the Upper Missouri, but does not abound on the richer soils eastward.

Bouteloua oligostachya, Torr.—This is one of the principal "grama grasses" of the plains and mountains, but this common name by no means applies to this species or to the several species of the genus exclusively, but is given by the mountain men to several other species of different genera. It is a most valuable species for grazing purposes, but grows too thinly and too short to be cut for hay. It abounds chiefly in the mountain regions and the adjacent plain districts, and may be readily distinguished from species of other genera by its peculiar spikelets of flowers all arranged on one side of the rachis, and pointing in one direction. It supports on its stalks from one to three or four and sometimes five of these spikes, which are purplish or of an indigo-blue tinge. Its general height is about twelve inches, but in sterile locations much less. The leaves and stems are smooth, having no hairs. It is perennial. Much of the beef of the Southwest is claimed to be the product of this grass.

Bouteloua hirsuta, Lagasca.—This much less valuable species so much resembles the foregoing that some care and close observation are necessary to discriminate between them. The spikes of flowers are shorter and more curved when mature, and present a bristly appearance from the numerous rigid hairs that grow from the conspicuous dark glands of the glumes. The leaves and stalks are also hairy. It generally grows shorter, and prefers more sterile situations, where sand and gravel abound. It is not a perfect perennial, but appears to be a biennial or something like a winter annual. It is not esteemed as a forage plant.

Bouteloua curtipendula, Gray.—This beautiful species is at once distinguished from the others by its long, slender raceme of numerous (twenty to fifty, or more) spikes. These are small, horizontally bent or reflexed, and sometimes, but not always, purplish. It grows two to three feet high, is perennial, but the foliage is scanty, and as a forage plant it is not highly valued. It abounds in many localities on the plains and mountains.

Spartina cynosuroides, Willd.—The fresh-water cord-grass of the whole country abounds also in suitable situations there, and, as in the States east of the Missouri, is frequently cut for hay, but it makes only a miserable substitute for that article. No animal will eat it until driven by a degree of hunger approaching starvation. It is to be regretted that this abominable fare is still provided for the faithful beasts that contribute so much to the wealth and happiness of man. The western cities and towns continue to store it largely for feed for horses, simply for the reason that it may be easily obtained, or is cheap, to the exclusion of the nutritious and savory *Andropogon*, *Sorghum*, and *Sporobolus*, which merciless, mercenary practice cannot be too strongly condemned.

Festuca ovina, Lin.—In the mountain regions and adjacent plains this species is plentiful, and contributes largely to the general forage crop of the country. It is esteemed a nutritious grass, notwithstanding the hard, wire-like appearance of its leaves and culms. The species is variable, and includes very different forms, arising in part from the conditions of locations. It attains to the height of about two feet at favorable stations, and grows chiefly in bunches or stools, with erect, straight, stiff culms, long, narrow leaves of pale-green color, and has numerous flat spikes of flowers in a small panicle, often purplish. The several varieties or forms of this "sheep's fescue" grass possess very different constitutional qualities as to naturalization tendencies, some forms being so sensitive to changed conditions that they cannot be made to survive artificial treatment.

Festuca macrostachya, Nutt.—A valuable annual species in the mountains of New Mexico, of very variable forms. It is one of the "grama grasses" of that region, from six to eighteen inches high, with a loose, lax panicle of small spikelets, bristle-pointed.

Bromus Kalmii, Gray.—Chiefly in the mountain districts. A slender, tall-growing grass, with a graceful panicle of drooping or nodding spikes of flowers. These are long and roundish, or flat when mature. Where plentiful it affords excellent pasturage.

Stipa viridula, Trin.—From four to six feet high in favorable situations, with a plentiful supply of large flat leaves. A considerable amount of the mountain grazing comes from this species.

Poa serotina, Ehrh., and the other species enumerated in the catalogue, abound plentifully in the higher as well as in the low mountain districts, and are all rich, nutritious grasses, and, where abundant, afford valuable food for all kinds of stock.

Triticum caninum, *repens*, and *ægilopoides* contribute largely to the pasturage of some districts, and are not deemed so valueless as in the East, and, with a few other species in particular localities, are the chief reliance for grazing animals in these neighborhoods.

The *Cyperaceæ* are largely consumed by stock, and are even made into hay where abundant. The large family of *Carex* afford the best species. Though less nutritious and palatable than most of the true graminaceous plants, they are highly valued and largely used in some mountain districts. *Carex Gayana*, Desf., in the mountain valleys of Colorado Territory, affords the principal hay of the country, but many other species are used for both hay and pasturage. The relative value of the several species depends more on quantity than quality, excluding a few of the coarse aquatic kinds that are quite worthless.

The comparatively few species above described embrace the chief grazing resources of the region under consideration, and these resources are conceded by every one to be the principal source of the wealth of the country. The early pioneer, however, has already learned how soon the native grasses are destroyed by the clipping and treading of domestic animals, and he sees with regret their places immediately occupied by *Erigeron Canadense*, Lin.; *Ambrosia psilostachya*, D. C.; *Ambrosia artemisiæfolia*, Lin.; *Iva ciliata*, Willd.; *Iva xanthiifolia*, Nutt.; *Monolepis Nuttalliana*, Moq.; *Amaranthus blitum*, Lin.; *Polygonum aviculare*, Lin.; *Solanum rostratum*, Dun.; *Helianthus lenticularis*, Nutt.; *H. rigidus*, Desf.; *H. mollis*, Lam.; *Dysodia chrysanthemoides*, Lagasca; *Abutilon avicennæ*, Gærtn.; *Datura stramonium*, Lin.; *Erigeron divaricatum*, Michx.; *Panicum capillare*, Lin.; *Panicum sanguinale*, Lin.; *Panicum filiforme*, Lin.; *Eragrostis megastachya*, Link.; *Vilfa vaginæflora*, Torr.; and *Aristida dichotoma*, Michx.; worthless weeds and grasses, that occupy the soil to the exclusion of every profitable production. He sees that, as settlement progresses and domestic animals increase, the natural pastures diminish, and he recognizes the inevitable destiny of the grass product, which is the principal resource of his country, unless it can be supplied by cultivated species, and he naturally turns his attention and directs his labors to this task. The test of experiment alone is to demonstrate the practicability of his work. The settler finds the climate peculiar and extreme; not uniform in its several seasons, yet possessing extreme general characteristics, to which he must conform his operations to be successful. Knowing that the greatest wealth of a nation springs indirectly from its agriculture, and that the latter is completely successful only when it adapts itself to existing conditions; that no conquest over nature pays the cost of the warfare with its spoils,

and that a persistent antagonism is not profitable to any people; and being without a successful precedent under similar climatic and soil conditions in this country, original experiments must form the basis of operations. The test of species by sowing their seeds in plowed land, and leaving them without further assistance to establish and defend themselves against the encroachments of native and naturalized foreign worthless weeds and grasses, should be the plan of experiment; for, however well a species might succeed with careful cultivation, unless it is capacitated to maintain its existence in a strong contest with competitors, it cannot be profitable as a cultivated grass. From the peculiar character of American climate and soil, or the very unequal powers of our grasses for territorial conquest, we expect to find but one, or at most but few species adapted to any locality or situation. We are told that twenty-two species have been counted on a square foot in a rich old pasture in England. Such a result in this country is utterly impossible. Monopoly is the law of our species, and only local conditions arrest the domination of the strong. It is natural that we should expect to find in some native species of the plains or mountains the successful plant or plants already adapted to the peculiar climatic conditions of the country; but we must remember that soil conditions have also very much to do with the growth of plants, and that settlement and cultivation greatly change the conditions of the soils of any country. With these facts before us, our experimental operations may be more intelligently pursued. The plant required is one that will do for the coarse, open, and airy soil of the plains, which is often dry for a long time, what *Poa pratensis*, Lin., has done and is doing for the States east of the Missouri River within the same parallels; one that will not only maintain its footing, but will extend its area, and overcome competitors, as *Poa pratensis* has done in several of the States east, and which now forms the best pasture lands in the Union, monopolizing the entire soil product on thousands of acres. This species, however, being adapted only to finely comminuted soils, moist during the period of its growth, does not succeed satisfactorily, though in some localities on the eastern confines of the district it maintains a feeble existence. A strong-growing, coarse perennial, with rhizomas, or underground root-stalks, would suggest itself as a suitable species for trial; or a perennial producing an abundance of radical leaves, and of early growth, that would cover the soil and prevent the growth of annuals. Of this class we suggest the following for experiment:

Elymus Canadensis, Lin.—A native over a large area of North America; has been cultivated in Europe, but was soon discarded on account of its coarse character as compared with the pasture and hay grasses of that country.

Elymus Virginicus, Lin.—A hardy species of early growth, producing an abundance of large, succulent leaves when young; a widely distributed species in America. Cultivation greatly accelerates its growth. It is a promising species.

Elymus Sibiricus, Lin.—Native of Europe and America in the colder latitudes; would probably succeed well in the northern districts, where it is native.

Elymus mollis, Trin.—Grows early and spreads rapidly by its running root-stalks; foliage, when young, tender and juicy. It thrives well in situations very different from its habitats, (sandy shores;) probably not adapted to a dry soil, but well worthy of trial; leaves broad, rather short, with a beautiful glaucous hue and strong *Triticum* flavor.

Sporobolus heterolepis, Gray.—A most valuable native species; should

be tried in cultivation for hay, but for pastures would doubtless soon be trod out by animals. Fields of this species, *Andropogon furcatus*, *Andropogon scoparius*, and *Sorghum nutans*, inclosed from stock and mowed only after full maturity in autumn, would long remain good natural meadows; and this plan will probably be adopted until the lands advance so much in value that the hay product alone will cease to be a paying crop.

Ceratochloa grandiflora, Hook.—This species inhabits the mountain districts and has a wide range, reaching the Pacific in some of its forms. It is a large species, growing three feet high, often more in good soils; not a coarse species for its size. Generically, this species is nearly related to *Bromus*, and much resembles *Bromus Kalmii*, but has much larger and broader spikes, not drooping as in that species. From its habit of growing a mass of radical leaves early in its season, preventing the growth of intruding annuals, it maintains its place in localities where there is strong native competition, and even extends its areas by means of its seeds. It is inclined to fall in storms in rich soil when in fruit. It should probably be cut for hay before the seed matures, unless the practice should be found to injure the vitality of the root. This species merits thorough trial in all localities.

In the mountain districts *Poa nemoralis* and *Poa serotina* may prove profitable pasture grasses; both are natives of the region, and worthy of trial in cultivation. *Agrostis vulgaris*, With., is a hardy species, tenacious of life, native of Europe and America; found in wet lands, but will thrive in dry, close soils. It may prove profitable in some localities for pasturage.

Of foreign species, perhaps the most promising is *Festuca pratensis*, Huds., similar to *Ceratochloa grandiflora*. This species grows an abundance of radical leaves, which retain their vitality through the autumn and into the early winter, and in the southern districts would probably remain green through the year. This is a large, tall-growing species, and not a very coarse grass. It is a native of Europe, and is there esteemed as a valuable hay and pasture grass. It has been introduced into this country, and cultivated in some localities.

Lolium perenne, Lin.—An Asiatic and European species, esteemed as a pasture grass in some parts of the country, and merits trial. *Phleum pratense*, Lin., will of course be tested thoroughly, but it is believed to succeed very indifferently throughout the whole extent of this region, on account of the open, light, porous soil not affording its roots the protection necessary to keep the plant from perishing during the summer droughts.

FOREST CULTURE.

European countries felt the necessity of forest planting many years ago, and England and Scotland can boast their thousands of acres of majestic pines, larches, and oaks at home, and their extensive groves of mahogany and other precious woods abroad. Germany has imported thousands of dollars' worth of seeds of the valuable redwood (*Sequoia sempervirens*) from California, and the young forests growing from them are the pride of that nation. It has also established special departments for forest culture, with the schools necessary to educate the officers in their duties in cultivating and protecting trees. France, Austria, and Russia adopted at an early day the same system for promoting forest cul-

ture, and the artificial forests of those countries rank among the most valuable government property. In this country the tendency toward forest planting is of slow development. The planting of protecting screens and borders has become more general on prairie farms, and State aid in the form of premiums has given some encouragement to forestry. The plains beyond the Missouri are now a promising theater of experiment. In many parts of the country forest planting, in the opinion of many observers, is changing the climate and capabilities of this region. Twenty years ago, before any considerable settlements were made, the plains were nearly destitute of trees, and vegetation was parched and scanty; but it is now claimed that in some localities where farms have been taken up, villages built, and trees planted, they are clothed with verdure, and river beds, which were then dry, are now covered with constantly running water. A part of the city of Denver was built on one of these ancient river beds, where it was supposed that water would never flow again, but there is now a constantly running stream, so large that it has been found necessary to bridge it. Great Salt Lake is said to be seven feet higher than it was ten years ago, and is constantly rising.

In France and Germany it has been estimated that at least one-fifth of the land should be planted with forest trees in order to maintain the proper hygrometric and electric equilibrium for successful farming. In some sections of New York, where the forest trees have been cut away, wheat now often fails, from winter-killing, although the soil is not exhausted, and is abundantly fertilized by the most approved manures. If such is the value of trees, the subject of forest planting demands the immediate attention of every cultivator of the soil, and should stimulate him to do all he can to advance this important national industry.

Mr. George Pinney, writing from Sturgeon Bay, Wisconsin, says that there are 10,000,000 acres of land in Wisconsin and the upper peninsula of Michigan, north of the forty-fourth degree of north latitude, which, previous to the settlements in that part of those States, were covered with forest growth valuable for timber, lumber, and fuel. Since that time at least one-half of this growth has been cut off, and the timber brought into market and sold; and 1,000,000 acres of the hardwood timber have been felled and burned upon the ground by the farmers while clearing up their farms. About 4,000,000 acres remain undisturbed. Along the rivers, most of which empty into Winnebago Lake, Green Bay, and Lake Michigan, lumber mills have been erected at Berlin, Omro, Fond du Lac, Oshkosh, Menasha, Appleton, De Pere, Green Bay, Kewaunee, Sturgeon Bay, Fish Creek, Duck Creek, Saunico, Oconto, Pensaukee, Peshtigo, Marinette, Menomonee, Cedar River, Ford River, Escanawba, Sturgeon River, Big Bay des Noquets, Upper Manistee, and several others near Mackinaw, making more than twenty-five shipping points, from some of which 100,000,000 feet of lumber are shipped annually, and from none less than 10,000,000, aggregating at least 700,000,000 feet, besides many small mills scattered through the country which ship annually 1,000,000 to 5,000,000 feet each, which might be safely estimated at 50,000,000 more, making an aggregate of 750,000,000 feet shipped annually from the lumber mills of this section of country. That this estimate is not too great is evident from the fact that 1,250,000,000 feet have been received during the past year at the various ports on Lake Michigan, nearly one-half of which has been brought from this region, and also that most of the products of the mills on Wolf River, which are supplied with lumber from the same place, are consumed on the spot or are shipped by railroad to the con-

sumers without reaching the lake ports, besides considerable quantities which are transported east through the Straits of Mackinaw. The quantity shipped down the various tributaries of the Mississippi, taken from this tract, is always greater than that by the lakes. Supposing it to be one-third greater, there would be 1,000,000,000 feet shipped from these tributaries, making a grand total of 1,750,000,000 feet of lumber taken annually from Wisconsin and the upper peninsula of Michigan.

The average yield of pine timber in this region is usually estimated, by practical lumbermen, at 300,000 feet per 40 acres. Some place it higher. Reckoning 333,000 feet, it would require a little more than 200,000 acres for the annual timber supply. If we add to this sum 100,000 acres for railroad ties, telegraph posts, hewn timber, shingles, and fire-wood, determined by actual amount received in Chicago market, and 30,000 acres for the amount cut and burned on the ground in clearing the land, we have 330,000 acres denuded annually. At this rate of consumption, all the valuable timber now remaining on this extensive tract will be consumed in the short space of twelve years, and the probability is that the portion lying east of Fox River and Green Bay will be gone in half that time. The hard-wood timber, principally cut for fire-wood, will doubtless continue longer, perhaps ten or twelve years. It is true, the lumbermen do not remove all the growth in cutting off the timber, but fires generally follow in their track, and consume what remains.

It is gratifying to note that the Northwest, where so rapid denudation is going on, is also foremost in remedial experiment. In Iowa, Illinois, and Missouri, timber is principally grown from the seeds of trees found in the native forests, and it is supposed that about 100,000,000 of such trees are planted annually in the prairie States. The firm of Pinney & Lawrence, of Sturgeon Bay, Wisconsin, sent to the prairie States 9,000,000 of trees in 1869–'70, and their shipments during the spring of 1871 will be 10,000,000 to 15,000,000. Robert Douglass, of Waukegan, Illinois, will ship as many more, and several other nurserymen will send out 100,000 to 1,000,000 each. Reckoning the number of trees shipped by the nurserymen at 50,000,000, the planting in the prairie States will amount to about 150,000,000 trees. The average number of trees required for an acre, as usually planted, is about 1,000. At this rate 150,000,000 trees would plant only 150,000 acres annually throughout all the West, which would not compensate for half the denudation in the district east of the Mississippi River, and to the north and west of Lake Michigan, as may be seen by the foregoing figures.

MODES OF PLANTING.

The elm and a few other species of trees ripen their seeds early in the season; the swamp maple (*Acer rubrum*,) and also the silver, about the 1st of June. The seeds of all these must be planted immediately after they are ripe, as they cannot often be kept through the winter. If planted carefully, and well rolled, they will germinate readily. The maple, the chestnut, oak, hickory, beech, black walnut, butternut, &c., which do not mature their seeds till autumn, should be planted soon after ripening, unless the climate is such as to cause frequent freezing and thawing of the ground. In this case it would be much safer to plant them early in the spring. They may be preserved throughout the winter in a tight box, (in alternate layers of sand and seed,) buried a foot deep in a dry and sandy knoll. The seeds will usually keep sound, and look nearly as fresh as when gathered from the tree. Black walnuts are gathered in the fall, and some cover them with leaves and a little

earth as soon as gathered, to keep them moist and well frozen during the winter, and plant them in the spring. The ground should be rolled as in the case of the maple.

A writer in the Iowa Homestead advises to plant the seeds of forest trees as early in spring as the ground will permit, at a distance of four or five feet between the rows, as convenience may suggest; and afterward at the proper season to plant potatoes, corn, or beans between the rows for two or three years, till the trees get started. In this way the trees can be kept clear of weeds, and a valuable farm crop raised. Care should be taken in cultivating the crop between the rows not to disturb the trees. He planted eight quarts of the seeds of the soft maple in this way on new land broken up in June, 1868, and in August of 1870 there were 2,500 trees two to three feet in height.

In planting nut-bearing forest trees for timber or fuel, the principle is pretty well settled that the seeds should be planted where the trees are intended to remain. The black and the white walnut, however, may be transplanted without very serious injury, but still they receive a shock which retards their growth for a considerable time. The chestnut, when transplanted, survives in some soils; in others it dies. The hickory and pecan are scarcely successful when transplanted.

A gentleman of Carroll County, Missouri, who has had large experience in planting chestnuts, states that he covers the nuts with leaves or stable straw two or three inches thick, when he plants them in the fall, and puts on no dirt. If he plants in spring, he soaks them in warm water for ten days, changing the water every day. He afterward sprouts them in sand till the tap-root makes its appearance, and then plants them in rows at desirable distances, and covers them with earth. The drying of the nuts in winter, he says, will not prevent them from growing in the spring, when treated as directed above.

Mr. S. M. Rothamer, of Iowa, a professional horticulturist and florist, says that the most successful way to raise a forest of conifers, or evergreen trees, which always need to be shaded for the first few years of their growth, is to plant deciduous trees first, and, two or three years after, a row of conifers between them. After the conifers have become large enough not to need shading, the deciduous trees may be cut out and used for fuel or other purposes. He advises that the seeds of conifers and nut-bearing trees be planted in shallow drills in October, and covered about an inch and a half deep. If it is impracticable to plant them in the fall, they should be exposed in shallow boxes to the winter frosts, having been previously mixed with clean sand, and then planted the next spring as soon as the ground is dry enough to be properly worked. Seeds planted in the fall usually produce plants two to six inches high before those of spring planting begin to germinate.

Mr. D. W. Adams, of Waukon, Allamakee County, Iowa, gives the following rules for planting forest trees:

1. Prepare the ground as for corn, and plant the seeds fresh from the tree.
2. Cover shallowly, and cultivate the trees in the same manner as corn, for three years, after which they will take care of themselves. Cotton-woods and willows are most easily grown from cuttings.
3. Plant the seeds and cuttings of deciduous trees where they are to remain, thus saving one year's growth and the labor of transplanting.
4. Never attempt to plant a grove with large trees taken from the woods, or in any case without good cultivation.
5. If evergreens are to be planted, it will usually be found cheapest to buy them of nurserymen, as more skill and patience are required to grow them than farmers usually possess.

Hon. Horace Greeley suggests that farmers in the Eastern States fence in a portion of their waste lands, such as rocky, craggy, naked hill-sides

and eminences, which have run out by pasturing, scratch over the ground with a plow where practicable, and pick over the remainder, and plant thickly with the seeds of valuable timber trees, as white oak, hickory, locust, or other desirable species which are adapted to the climate, and will grow in such places; and keep down the weeds for a year or two till the young trees get a start. In five years the small oaks and hickories may be cut out for hoop poles, and the more promising be allowed to grow. In two years after, another crop of poles may be removed. In this way the forest, after the first four years, may become a source of annual profit. The shade and leaves of the trees will destroy all the grass and weeds, induce moisture, and in twenty years the land will be covered with valuable timber. No better investment can be made, in his opinion, than working up these unsightly and barren lands into timber forests.

Mr. A. Tracy, of Spillville, Winnesheik County, Iowa, says that the cost of planting a grove of forest trees on prairie land is trifling. The first crop of wheat will pay for breaking the land, and then, after one deep plowing the next year, the ground is in a good condition for planting trees. The quickest and cheapest way to get a grove is from cuttings of the cotton-wood, Lombardy poplar, Balm of Gilead, (*Populus candicans*,) and the white willow. He makes rows four feet apart each way, plants the cuttings in the angles, and cultivates them at least two years. He plants acorns, chestnuts, black walnuts, butternuts, &c., in the same way, but cultivates them two or three years longer, as the trees from these nuts do not grow so fast as those from cuttings of the cotton-wood and other trees named. An acre planted in this way, with proper allowance for margins, contains 2,722 trees, and ten acres, 27,220. The trees from cuttings would grow about an inch in diameter yearly. Aside from the profit, Mr. Tracy thinks the increased value of the farm, the beauty and cheerfulness which the trees would impart, and the ameliorating climatic influences which they would produce, would doubly compensate for the expense of planting.

Mr. C. E. Whiting, of West Fork, Manona County, Iowa, has planted the cotton-wood and soft white maple (*Acer dasycarpum*) largely and successfully. He plants the seeds on cultivated ground, in rows four and one-half feet apart, and twenty-six inches in the rows, making about 4,350 trees to an acre. The first year they grow one to three feet, the second, four to eight, and at the end of the third their height is usually eighteen feet. They are cultivated for the first two years only, and when large enough for rails are thinned out to a proper distance. Cotton-wood will make four rails in seven to ten years, and maple the same number in eight to ten. Sugar may be made from the soft maple here referred to in eight years from planting. Some own planted forests, from which they make three to four hundred pounds of sugar in a season.

Mr. Whiting has also cultivated the black walnut largely, having planted sixty-five bushels of nuts in a single season. They are planted in rows five feet apart and two and a half in the rows. The young trees grow rapidly, making five to six feet the second year and five to seven the third. After the third year they grow nearly as fast as the maples, but cannot be so safely transplanted. The trees were planted upon the Missouri bottom, the soil of which is exceedingly rich and of great depth. The greatest difficulty which he has found is, to grow them slowly enough to avoid injury from winter frosts. He regards cotton-wood, soft maple, and black walnut as the most desirable trees for forest planting.

Mr. N. S. Ames, of Humboldt County, Iowa, estimates that six acres of

quick-growing trees, planted in rows four feet apart and one foot in the rows, will, in eight years from setting, furnish fuel for one stove continually, by thinning out as the trees increase in size, and the grove will be growing better from year to year. He favors planting groves closely. The trees quickly shade the ground and prevent the growth of weeds. In their stretch upward for light and heat, they send up straight, clean stems, requiring no labor with the pruning knife and little care from the husbandman until they are six years old, when one-half will need to be cut out.

Mr. Ames has a grove of white willow, (*Salix alba*,) planted five years ago, which will now average twenty to twenty-five feet in height; and two cotton-wood trees, (*Populus monilifera*,) which grew up spontaneously seven years ago, now thirty feet high and measuring, respectively, thirty-eight and thirty-nine inches in circumference; also a row of Lombardy poplars, (*Populus dilatata*,) three years from the cuttings, which average twelve feet in height.

When a quick-growing grove is desired for immediate returns or for shelter-belts around houses, barns, stock-yards, orchards, and gardens, he recommends to plant cuttings of the white willow and cotton-wood. Cuttings ten inches long and of the preceding year's growth should be set in rows, as given above, the ends being left one foot above the ground, and the earth pressed firmly around them. Sixteen rows will make a good wind-break. For general cultivation he recommends soft (red) maple, (*Acer rubrum*,) white ash, bass-wood, (*Tilia Americana*,) and European larch, (*Larix Europæa*.) The young maples planted in June appear above the ground in about ten days. He has a grove of soft maples planted six years ago. Many of them are twenty feet high and ten inches in circumference. White ashes planted seven years ago are fifteen feet high and eight inches in circumference. The seeds ripen in the fall, and should be gathered after the first hard frost and planted immediately. It is estimated that 15,000,000 trees have been planted in Iowa in 1870, and that the average for several years past is about 5,000,000. Two farmers of a town in this State have planted 25,000 forest trees this year.

The Farmers' institute of the Kansas Agricultural College, at Manhattan, recommends the following species of trees as most suitable for cultivation in Kansas; the ailanthus, ash, box-elder, catalpa, cedar, chestnut, coffee-bean, willow, cotton-wood, elm, hackberry, hickory, larch, linden, locust, maple, oak, Osage orange, pine, poplar, tulip tree, and walnut. More than half of these trees are native in that State.

Two gentlemen near Omaha, Douglas County, Nebraska, have about one hundred acres planted with black walnut, and the same number with cotton-wood and the soft and the ash-leafed maple, (*Negundo aceroides*.) This fall (1870) they intend to add seventy-five acres to the walnut plantation, and next spring two hundred more, principally black walnut, but some cotton-wood and maple.

In the counties of Nemaha and Richardson, Nebraska, at least a million sprouts of the cotton-wood have been pulled up from the bottom lands and islands of the Missouri River, and carried back, in some instances one hundred miles, and set out for timber lots. One individual took 30,000 in one week to Pawnee County for this purpose. Each farmer sets a forest in that part of his farm which is most convenient, and best adapted to its growth.

Mr. F. F. Aiken, of Sacramento County, California, has planted this year 5,000 Lombardy poplar and Balm of Gilead trees; 10,000 California black walnut; 4,000 American white maple; 5,000 American

white elm; 2,000 English elm; 400 Spanish chestnut, and 500 American chestnut. The last five kinds were brought from the Atlantic States. They have succeeded so well that he has ordered several thousand, which he will plant the coming season. The elms and maples have grown four to seven feet this year. Mr. Thomas Edwards, of the same county, has set 7,000 locust trees, one-half of which have been set in forest form one year, and the other half two years. When planted they were two years old from the seeds, and were set in alternate rows eight and ten feet apart, respectively. He estimates the probable expense of care and cultivation at about $10 per year, and remarks that he expects to have, in ten years, fence posts enough from them to fence all his own land, and some to sell to his neighbors. Mr. James T. Stratton, of Alameda County, has planted fifty-three and one-half acres with 30,000 blue-gum trees, (*Eucalyptus globulus*,) and 13,000 red-gum, (*Eucalyptus resinifera*.) They were grown from seeds gathered in December, 1868, from trees only seven years old; and in August of this year were, on an average, four and one-half feet high. They were planted eight feet apart each way. Mr. Stratton thinks that in seven years they will be large enough to afford some income. These trees are natives of Australia, and are of rapid growth. The red-gum sometimes grows to the height of one hundred and fifty to two hundred feet, and yields a valuable resin. A plank of the *Eucalyptus* was exhibited at the great exhibition in 1857, which had a length of one hundred and forty-eight feet. The wood, when green, is soft and easily split, but when dry is very hard. The trees are used extensively for piles, flooring, ship-building, and other mechanical purposes.

PROFITS OF CULTURE.

Of the profits of culture in this country, estimates can only be given at the present early stage of tree-planting. Sufficient data concerning the rate of growth and numbers likely to thrive upon a given area are available for a calculation of profits based on present prices. It may be proper to give the estimate of a few practical men, from the facts noted in their experience and observation. Mr. Joseph L. Budd, of Shellsburg, Iowa, says that a grove of ten acres of white ash, (*Fraxinus Americana*,) thinned to six feet apart each way, containing about twelve thousand trees, will average at twelve years of age, on good prairie soil, about eight inches in diameter. The previous thinnings will pay for cultivating to this time. Ten feet of the butt of each tree will be worth for mechanical purposes 40 cents, and the remaining tops 10 cents each, making for the twelve thousand butts, $4,800; and for the tops of the same $1,200, total $6,000 for the profit of ten acres in twelve years. By cutting the stumps close to the ground, and covering them with a light furrow on each side, sprouts will spring up which, by proper pruning, will produce in eight years a crop as valuable as the first. He also assumes that ten acres of the black ash, (*Fraxinus sambucifolia*,) planted for hoop poles, in rows four feet apart, and one foot in the rows, will yield at the first thinning of half the trees at the end of five years, at 3 cents per pole, $1,620, which will pay all the expense of cultivation, and interest on the land. The whole remaining crop of 54,000 poles, if cut two years later, at 6 cents each, the price of heavy poles, will amount to $3,240. These calculations are made from actual experiments, and at a low estimate of the value of the crop. If the poles are cut in the winter or early spring, the sprouts which grow up, if properly thinned out, will produce a crop of light poles at the end of three years, and of heavy ones at the end of five years. It will be seen from these estimates that the profit from

forest culture is much greater than from wheat, corn, or other farm crops.

The chestnut is of rapid growth, and will thrive on almost any soil. It will mature a crop of nuts in eight or ten years from planting, and is especially valuable for timber. The demand for the nuts in the market is almost always greater than the supply. Those of the American chestnut are much superior in quality to the Spanish, the French, or the Italian variety. Groves of this tree can be planted with profit in a suitable climate where scrub-land is abundant and timber scarce.

A gentleman of Panora, Guthrie County, Iowa, states that fifteen cotton-woods were planted about fifteen years ago. In twelve years he cut down eleven of them, from which he obtained five cords of wood. Three years after he cut the remaining four, which made two cords of wood and seven hundred feet of lumber. The lumber, at $2\frac{1}{2}$ cents per foot, was worth $17 50. The wood from the fifteen trees, at $4 per cord, was worth $28, making a total value of $45 50 for the fifteen trees. They covered about one-sixteenth of an acre. At this rate, one acre would be worth $728 in about fifteen years. More than two-thirds might be cut off at the end of twelve years.

Mr. H. C. Raymond, of Pottawatomie County, Iowa, says that thirty cotton-wood trees were planted twelve years ago, being two feet high when planted. They will now make over one-third of a cord each. Deducting forty-four trees for vacancies occasioned by dying out, an acre will contain about five hundred trees, if planted in rows ten feet apart and eight feet in the row. Dry cotton-wood is now worth, in Council Bluffs, $9 per cord. The cost of planting, cultivating, and the interest on one acre of land for twelve years will not exceed $100. He estimates that at the end of twelve years the trees will make 167 cords, worth $1,503. Deducting $501 for chopping and hauling, at $1 and $2 per cord, respectively, and $100 for cultivating, we have $902 for the value of the wood at the end of twelve years, making a net profit of about $75 for each year.

A maple grove near St. Johnsbury, Vermont, occupies the site of a corn field of sixty-four years ago. It is a natural growth, has twice produced a quantity of valuable wood in thinning, has been used as a sugar orchard for six to eight years, and is deemed worth $200 per acre.

Dr. John A. Warder, of Cincinnati, recently measured a number of trees planted twenty years ago in Springfield, Ohio, with the following result, the measurement being taken one foot above the ground: European larch, $19\frac{1}{3}$ inches; paper birch, $16\frac{1}{3}$; red cedar, $9\frac{1}{3}$; white elm, $11\frac{1}{3}$; white pine, $14\frac{1}{3}$; Norway spruce, 14; Austrian pine, 15; ailanthus, 15; burr oak, 15; silver poplar, $17\frac{1}{3}$ inches. The following were on cultivated ground: White or paper birch, 14 inches; silver pine, $14\frac{1}{3}$; European larch, 18; deciduous cypress, 20 inches.

Dr. Warder recommends that the farmers of Ohio plant one-fourth of their farms with timber forests. He thinks that the increased product of the remainder would fully make up for the loss of the one-fourth, in consequence of the benefits of the shelter alone, besides the timber and wood produced. He would plant the trees four to six feet apart, that they may grow tall, and not need to be trimmed. He thinks that the black locust (*Gleditschia triacanthos*) is a very valuable species for cultivation, on account of its rapid growth, firmness, and great durability. He recently sold one acre of forest trees of this species, scarcely a tree of which was over fifteen years old, for $1,000. The timber was used for paving the streets in Cincinnati; and, from experiments which have been made, it

is found to be a very valuable article for this purpose. Colonel Richmond, of Sandusky, about eighteen years ago planted a piece of burnt land with these trees, after having cultivated it a few years with other crops, and now they are about forty feet high, and young trees are coming up from their seeds all through the forest. The borer has not troubled the trees much in this section of the country when they have been planted in large groves or masses.

Mr. D. C. Scofield, of Elgin, Illinois, says that pine and larch, as demonstrated in his own grounds, attain the height of thirty to thirty-five feet, with a diameter of eight to twelve inches at the collar, in twelve years. He would plant three feet apart, every fourth tree each way a pine, the remainder larches, a proportion of one to sixteen, giving the pines twelve feet each way. One square yard to each would admit of 4,840 trees on one acre; but Mr. S. abates a few for possible losses, and supposes 4,800 trees, of which 300 are pines, and proposes to cut out 2,400 larches at the end of seven years; 1,200 more at the end of fourteen years; 600 at the end of twenty-one years, and the remaining 300 larches at the end of thirty years, leaving three hundred pines twelve feet apart each way. He figures the yield as follows:

2,400 trees as grape stakes, at 5 cents	$120
1,200 trees as fence posts, (4,000, at 25 cents)	1,000
600 trees, at $3	1,800
300 trees, at $20	6,000
4,500 trees, aggregating in thirty years	8,920

He values the remaining pines at $6,000, to be worth $9,000 in ten years more, and $15,000 in twenty years, making in all, at the end of fifty years, $23,920. This is of course hypothesis, and perhaps extravagance, which the reader may abate in accordance with his own judgment.

While the public mind should be guarded against extravagant estimates, in which the proceeds of a large area are based upon the growth and yield of a few trees, it is proper to note the results of judgment in selecting, system and care in planting, skill in cutting and marketing, which in foreign countries have transmuted rose-colored theories into golden reality in actual practice. Making due and heavy allowance for the estimates of individuals presented in these pages, for drawbacks which are sure to meet the tree-planter at every turn, there is still abundant margin for profit and inducement for effort, which should lead to the extension of forest culture till the West shall have a larger area in timber than when the era of settlement commenced.

LAWS FOR ENCOURAGING FOREST CULTURE.

The legislature of Missouri passed a law the present year for the encouragement of forest culture, by which any person who will plant an acre or more of forest trees, or a row one-fourth of a mile long, with the trees a rod apart, on his own land, shall receive, after cultivating them three years, a bounty of $2 yearly for fifteen years, provided the trees in the mean time shall be kept alive and in a growing condition. The Massachusetts Society for Promoting Agriculture offered, in 1858, a premium of $1,000 for the best plantation of forest trees growing in 1870, and planted in 1860. That premium has been awarded to Major Ben. Perley Poore. The California State Board of Agriculture offered, last spring, $50 for the largest quantity of useful forest trees planted during the year. The Board of Directors of the State Agricultural So-

ciety of Illinois offered a premium of $1,000, payable in 1881, for the best ten acres of artificial timber forest. In 1865 Nebraska enacted a law for encouraging forest culture. The State of New York is paying bounties for the same purpose, through her agricultural societies. In Europe the governments foster this industry by various and effective means, and are making it a specialty of national interest.

SILK CULTURE.

Some progress in silk culture has recently been made in California. The disease prevailing among silk-worms in the south of Europe has, for several years, created a large demand for silk-worm eggs, and a lucrative trade with France, Italy, and China has been carried on. At the present time, however, as a consequence of the war between France and Germany, this industry has suffered an unexpected check, as orders received from Paris last spring for large quantities of eggs were countermanded after the commencement of the war, which has rendered the product of the year almost an entire loss. This contingency, which is only temporary, will not be likely to happen again very soon, and such is the encouragement for the production of eggs and cocoons in future, that more mulberry trees have been planted in the State this season than in any former year. Sericulturists are sanguine that the business will soon be much better than ever before.

In 1868 an act was passed by the legislature of California for the encouragement of silk culture, and bounties have since been paid to the following persons in the counties named: To H. G. Ballou, of Yolo, $300 for 100,000 cocoons; to Mrs. E. M. Weston, of Sacramento, $1,875 for 625,000 cocoons; to S. J. Scuffregan and Leon Gambert, of Santa Clara, $250 each; to A. Packard, of Santa Barbara, $450 for 150,000 cocoons; to A. Isoard and A. Miller, of Nevada, $250 each.

Silk-worms were first hatched in California in 1860, and numbered about 500; in 1866, the number was estimated at 300,000; in 1867, 500,000; in 1868, 2,700,000; in 1869, 3,500,000. In June last the Scientific Press expressed the opinion that there would be 25,000,000 in 1870. Mr. William Agnes, an experienced silk manufacturer, considers the raw silk produced there equal to the best India or Japan. Mr. Ryle, of Paterson, New Jersey, expresses the same opinion. The fiber is very strong, fine, free from all impurities, and remarkably smooth and glossy.

Mr. Leon Gambert, of East San José, who has been breeding silk-worms for the past two years, and received this year a premium of $250 for silk culture, has 5,000 mulberry trees of the *Moretti* or Italian variety, besides 10,000 of the same kind in a nursery, some of which are two and others three years old, valued, respectively, at $10 and $15 per hundred. He considers the *Moretti* variety the best for silk-worms. Last year he raised seventy ounces of eggs, worth $8 per ounce. All the work of feeding and tending was done by one lady. This year he is hatching three and one-half ounces of eggs, from which he expects to get about 140,000 silk-worms. These worms will produce moths enough to lay 460 ounces of eggs, worth $3,680. One hundred and fifty female moths will lay an ounce of eggs. But, as about one-half the number of the moths from the cocoons are males, 300 cocoons are usually considered necessary to produce moths enough to yield one ounce of eggs. His silk-worms

are of the French variety, which he says will produce the strongest and best silk. The Japanese silk-worms do not succeed well, and are not worth so much by one-third as the French. He sells his cocoons in European markets, to which they may be transported with perfect safety.

The worms when first hatched are fed upon the tenderest leaves, the tip ends of the growing side-shoots being used for this purpose. When the worms become older and stronger, larger leaves are used, and so on till they are full-grown, when they require the strongest food. They are fed upon shelves, on which the leaves are strewn in the form of a ring or wreath about a foot in diameter. This method is found to be the most favorable for ventilation and cleanliness.

Mr. Jesse Williams, whose farm is seven miles from Watsonville, in Santa Cruz County, which joins Santa Clara County, has three acres of land planted with mulberry trees of the *multicaulis* variety, which he regards as the best for feeding silk-worms when the production of eggs is more of an object than that of silk. His trees are three years old, and he prunes them back, so as to give them a bushy form, with numerous small shoots and limbs. He says that he can get more leaves and of better quality by this method of training. He is hatching this season 150,000 worms from four ounces of eggs. The trees on the three acres will afford an ample supply for feeding them. He has a separate building for a breeding-room, to which plenty of air can be admitted, although a strong draught is not allowed to blow upon the worms. He expects to produce 500 ounces of eggs this year, which will be sufficient to hatch 20,000,000 of worms. It is his intention also to plant this year 5,000 more trees, and to build a cocoonery which will be of sufficient size to accommodate 2,000,000 worms.

The reports of the surveyor general of California exhibit a production of 8,200 pounds of cocoons in 1868, against 3,043 pounds in 1867. The number of mulberry trees reported in 1868 was 374,125, against 356,053 in 1867.

Mr. J. N. Hoag, of Yolo, in the season of 1869, from fifty to sixty acres of land, containing 300,000 trees, fed 1,500,000 worms.

Mr. E. Muller, of Nevada County, from 105,000 trees fed 50,000 worms. He states that his best eggs are those exposed all winter on his trees, at an elevation of 1,800 feet above the level of the sea.

Mr. Albert Brewster, a sericulturist of Los Angeles, is feeding his worms with branches this year, thus saving the labor of pulling the leaves. He says this season has been more favorable than the last. The worms have been longer in maturing than if the weather had been warmer, but they could not be more healthy. About 60,000 of his worms had commenced to spin their cocoons; the remainder, about 200,000, were yet small, being more recently hatched. The winter which followed the prosperous silk season of 1868, in California, was open and pleasant; but the following spring was late, cold, and unfavorable to a healthy growth of the mulberry leaf. The electric condition of the atmosphere was unusually disturbed; and, until late in June, showers were almost uniformly followed by cold and disagreeable weather.

The effects of an exceptional season were plainly visible in the foliage of the peach, and the irregular growth and deficient flavor of its fruit, and in an unevenness of growth in the hop fields, such as had never before been observed in the State. Apiarists experienced an unaccustomed loss of bees, and a deficiency in proportional product and in the quality of honey; and a significant fact to naturalists was the scarcity of butterflies, usually so abundant at certain seasons. These peculiari-

ties of the spring of 1869 caused the loss of a large portion of the first feeding in that year, and threw a temporary discouragement over the minds of beginners in silk culture, who had indulged sanguine expectations from the prosperity of that industry in former years.

Mr. J. N. Hoag, of Yolo, a prominent silk culturist, incited by the deep interest felt in the subject, published a resumé of his experience, during the season of 1869, in the Transactions of the State Agricultural Society, in which, alluding to the facts already stated, he showed that the misfortunes of the season were no just grounds for discouragement as to the future; that they would in fact become rather a benefit than otherwise, by creating, at this early stage of a vast prospective business, a better understanding of the modes of culture best adapted to California regions; and that a large proportion of the losses of the season was owing to needless and injurious precautionary measures, founded on the practice of European countries, where, by reason of less favorable climates, the artificial processes are resorted to.

The errors committed by himself and other silk culturists consisted in the excessive and ill-timed use of refrigerator boxes, and other means of retarding hatching till a late and more favorable period of the season. Too great use also was made of artificial heat at the period of hatching, in an unwise anxiety for exact regularity of temperature. Another cause of mischief was the excessive cutting back of mulberry trees, to supply demands for cuttings, resulting, through the aid of unfavorable meteorological conditions, in so large an absorption of water by the leaves as to render them unhealthy food for silk-worms.

As an example of the special profits derivable from growing silk-worm eggs, he states that, in 1868, he fed the leaves from three and one-half acres covered with two-year-old *Morus multicaulis* trees, grown from cuttings without transplanting, and cut back in the spring or winter close to the ground, the tops being used for cuttings, so that they furnished but little more than half the early foliage which they would have afforded if they had been pruned only with a view to feeding purposes. The feeding was commenced June 1, and completed July 25. The following is a statement of receipts, expenses, and resulting profits:

486$\frac{11}{16}$ ounces eggs, sold to H. and B., at $4 per ounce	$1,946 70
Value of eggs sold to other parties, and eggs retained	1,897 50
Perforated cocoons sold	75 30
Total receipts	3,919 50
Expenses of labor, &c	472 00
Profit	3,447 50

This result shows an average net profit per acre of $985, obtained on fifty-five days' feeding.

Mr. H. G. Ballou, of Yolo County, states that from one-tenth of an acre of two-year-old trees which were suffering greatly from neglect, and were very uneven in growth, he obtained 600 pounds of leaves, being at the rate of 6,000 pounds of leaves per acre. Procuring an additional supply from another source, he used 1,500 pounds of leaves, equivalent to the foliage of one-quarter of an acre, with which he matured the worms from one ounce of eggs of the French variety, this crop of worms producing sixty ounces of eggs, worth $240, and twelve pounds of perforated cocoons, worth $9, making a total of $249 as the gross product of one-quarter of an acre, or $996 per acre.

The profit on eggs and cocoons made by Mr. T. B. Flint, of Sacra-

mento, from the feeding of one acre, is estimated at $1,261, after deducting $175 for expense of feeding.

Mr. Hoag asserts that by cultivating the trees as dwarfs, planted near together, twice as much foliage per acre can be grown at each crop as can be obtained by the orchard system of large trees, which is necessary in the more moist climates of Southern Europe; and, as in California two crops of leaves can be gathered yearly without injury to the trees, the yield of leaves there would be to that of Europe as four to one, amounting to about 64,000 pounds per acre yearly, sufficient for the production of 640 pounds of reeled silk, at the usual rate of one pound of reeled silk from 100 pounds of leaves. Reeled silk, even of poor quality, is worth $7 per pound throughout the world, while exhibits of the San Francisco market in 1869 show prices of California reeled silk from trivoltine Japanese worms reaching $9 per pound, and from the annual varieties, $12 to $15 per pound. Taking $7 per pound as the average value, the annual product of reeled silk from one acre of leafage would be $4,480. The expense account is stated as follows: Rent of land and cocoonery, $50; cost of cultivation of land, and feeding worms, $800; hire of Chinese or of white girls or boys, in reeling silk, 1,280 days' work, putting the price of a day's work at $1 for one-half pound of reeled silk, $1,280; total expense, $2,130; leaving a net profit of $2,350.

Mr. Hoag advises farmers in California to prosecute silk culture in conjunction with the usual branches of agriculture, except in the coast counties, where the climate in summer and autumn is damp and foggy, and asserts that mulberry trees are more readily and cheaply grown than fruit trees, and that any person can in an hour's time be taught in the cocoonery how to manage and feed the worms, and save and cure the cocoons for market; and that, with four days of instruction and three weeks of practice, a woman or girl can become expert in the art of reeling silk.

The foreign silk-worm which feeds upon the ailanthus, introduced into the United States years ago, is found in abundance in different parts of the country, yet little has been accomplished in utilizing its cocoons. A more particular statement of its distribution and comparative value, and of the introduction of the oak-feeding worm, may be found in the report of the Entomologist in this volume.

SILK MANUFACTURE.

In the Northern States silk is manufactured into dress goods, ribbons, velvets, and trimmings, the amount, according to statements in commercial papers, being variously estimated at $10,000,000 to $20,000,000 worth annually. We have found it difficult to obtain reliable information, and cannot vouch for the absolute correctness of the following affirmations and figures, but present for what they are worth statements apparently reliable. Boston reports fifty silk factories, mainly engaged in the manufacture of velvets; New York City, fifty; and the business is carried on extensively in Schenectady, Troy, Yonkers, and at Oneida, by the Oneida Community, who commenced late in 1866, manufacturing nearly $25,000 worth in 1867, and now employ 130 female operatives in their silk factories. A considerable business is done at Mansfield, Hatfield, and Manchester, in Connecticut. A company in Manchester is said to fabricate yearly 60,000 pounds of "thrown silk," 60,000 pounds of "patent spun," 100,000 pieces of belt ribbon, and 600,000 yards of wide goods, consisting of dress silks, gros grains, poplins, foulards, and pongees, and employs 1,000 operatives. The capital invested in Massachusetts, New York, and Connecticut, is $5,000,000. Philadelphia has

thirty factories, with a capital of $1,500,000. Paterson, New Jersey, has fifteen factories. One corporation manufactures every month 3,000 pounds of silk thread, 1,000 gross of silk braids, 600 gross of hat bands, 350 yards of serge, and employs 300 operatives, mostly children. Another makes 70,000 yards of dress trimmings monthly. The aggregate number of persons employed in the factories at Paterson is 3,500, and there are 70,000 spindles. The raw silk used by these companies is imported from China and Japan free of duty, but first passes through the English market, where the prices are fixed.

Mr. E. V. De Boissiere, a wealthy French gentleman, has engaged in silk culture and manufacture near Williamsburg, Franklin County, Kansas, upon an estate of 3,200 acres. He has already planted over half a million of young mulberry and ailanthus trees, raised from seed imported from France, China, and California, and is every year enlarging the area of his groves. He proposes to raise his own stock of raw material, which he thinks will be easily accomplished when his trees have fully matured. Until these become available for feeding, he will import from China, France, and other foreign countries, a supply of material for his manufacturing enterprise. The cotton fiber used in some of his fabrics he is compelled to procure in Manchester, England, none of sufficient fineness being yet produced in this country.

The erection of buildings designed to accommodate both the looms and the weavers, with their families, has already been commenced. One large frame building is occupied by two families, with looms for weaving dress silks. Another still larger building has been erected for the accommodation of a number of families and for a velvet-ribbon loom. A large stone factory has just been completed, in which will be placed three velvet-ribbon looms, with machinery for making silk thread, twist, &c. All of this machinery has arrived in this country, and will be immediately set in operation. The velvet-ribbon loom now in operation produces 250 to 300 yards of ribbon per day, or 28 double pieces, woven back to back, with a nap or plush connecting them, which is cut by a knife vibrating with the movement of the loom. In some of the lower-priced fabrics the warp is wholly or partly cotton.

Mr. De Boissiere exhibited at the late Ottawa County fair several specimens of silk velvet ribbon, which, in fineness of texture, compactness of fabrication, and brilliancy of color, will compare favorably, it is claimed, with the most elaborate products of the Old World. This branch of silk manufacture has hitherto been confined mostly to a few localities in France.

Some of the features of coöperative associations have been adopted in this enterprise. Mr. De Boissiere proposes to erect a building 300 feet long by 150 wide, three stories high, with an open court 200 feet by 100, for the accommodation of female specialties. A common refectory will be provided, and subsistence offered at the low prices attainable by this method. He is now importing from France fresh supplies of skilled labor and machinery.

The California Silk Manufacturing Company, which was organized March 4, 1870, with a capital of $50,000, has engaged an experienced silk manufacturer, and proposes to erect immediately a factory building 125 feet long, 50 wide, and two stories high. The culture and manufacture of silk bid fair to become one of the most important interests in the State.

DISEASES OF THE SILK-WORM.

A writer in the North China Daily News, of June 30, 1870, says that

the silk-worm disease, the *pèbrine*, has recently been discovered in the eggs of the silk-worms of Japan, notwithstanding the distinct declaration of the Italian commission to the contrary. It first exhibits itself in the form of a corpuscle in the egg, and is said to be contagious and organic, and capable of transmission by propagation. An examination of fifty cards being made by Lewis Crivelli, only six were found to be sound. The Italian congress called to investigate the subject came to the conclusion that the disease has its origin in this corpuscle. The Japanese, therefore, have now to contend with this disease, and also with another, called the *uji*, besides an enfeebled state of the silk-worm, caused probably by the enormous demands for the eggs during a few years past. These difficulties are very formidable, and will require the most energetic efforts on the part of the silk-growers and the Japanese government to counteract them. The government has already distributed throughout the silk districts Mr. Adams's report on the *uji*, in which he describes how it fastens itself on the young worms, and deposits its eggs within their skins. He shows the necessity of destroying the *uji* at once, instead of throwing it away as if a dead insect, when in reality it is a living one in the grub state. He recommends further that when silk-worms are about to spin their cocoons, the peasants should separate all those worms which, from the black mark on them, are known to contain *uji*, and suffocate all the cocoons which they produce, thus destroying the *uji* at the same time. These cocoons would, of course, be used for silk. The home department of Japan has called the careful attention of the silk-producers to the various diseases to which the silk-worm is liable, and has demanded that they should search out the causes which produce them, instead of referring them to a supernatural power over which man has no control. It has also offered honorable mention and liberal rewards to those who will discover the best methods of eradicating the disease, or of improving the breed or the system of rearing the worms. It is confidently expected that these efforts of the government will result favorably in putting an end to these diseases, and bringing the silk production up to its original standard.

It is supposed by some that the disease is caused by a small fly which deposits its eggs on the silk-worm just before the latter enters the cocoon. These eggs, adhering to the worm, are carried into the cocoon, where they hatch about the time the cocoon is finished, producing very small maggots, which prey upon and destroy the chrysalis.

Dr. Tryski, the Austrian commissioner to Japan, visiting California on his way home, informed Mr. Hoag that the losses of cocoons set aside for eggs in Japan, in 1869, ranged from 30 to 75 per cent., the usual supply of eggs being diminished in corresponding proportion. As a consequence, eggs commanded $4 50 to $5 per ounce; but notwithstanding this high price, there had been shipped to Europe, up to the time of his leaving Japan, 1,300,000 ounces, at a cost in Japan of about $5,850,000, the shipment being still in progress, and estimated to reach for the year 2,000,000 ounces, at a cost of $9,000,000. He also stated that California had the power to secure this trade, for the reason that the disease mentioned is extending its ravages in Japan, causing serious diminution in the supply of eggs and a corresponding increase in price.

Professor Tyndall, in an address recently delivered in Liverpool before the British Association, estimates that France has sustained a loss of $242,000,000 within the last seventeen years, caused by the *pèbrine*, or silk-worm disease.

M. Sintrae, of France, has made a series of experiments, which he has communicated to the Academy of Sciences in Paris, to ascertain the

cause of the silk-worm disease now so prevalent in that country and other parts of Europe and Asia. From his experiments he concludes, that the worms succeed much better when raised in the open air than when kept in close rooms at high temperatures, as is usually the case; that they bear very well a temperature as low as 47° and as high as 104°; and that they are not injured by the direct rays of the sun nor by sudden changes of temperature. He attributes the disease to confinement in too close rooms, and recommends that they be kept in open sheds, with roofs sufficient to keep off the rain. Worms kept in this way yield very satisfactorily, 38 ounces of eggs furnishing sufficient silk-worms to produce 372 pounds of cocoons, besides a large number of eggs from which to rear a new stock.

SILK SUPPLY.

In consequence of the diseases of the silk-worm, the imports of raw silk into Great Britain have fallen off 40 per cent., and prices have risen 100 per cent. Many silk manufacturers have abandoned their business and sought other employment. Imports of silk from China into Great Britain, between the years 1857 and 1864, fell from 9,000,000 pounds per annum to 3,000,000 pounds; and in one year, 1864, they fell from 7,000,000 to 3,000,000 pounds. To remedy this evil, the silk manufacturers of England have formed a company, called the "Silk Supply Association," the object of which is to stimulate silk production by cottage culture, and in every other practicable way, in all countries where the silk-worm can be raised; to encourage the introduction and exchange of eggs of the best kinds of silk-worms; to impart practical suggestions to silk-producers for improving the quality of their silk and the manner of reeling it; to promote importations of cocoons from countries which have not facilities for reeling them; and to confer with all consular agents in foreign countries to secure their coöperation in promoting and extending the culture of silk in all places where they can exert an influence. The association has already published a "Guide to Sericulture," and intends soon to issue a monthly journal, called the Journal of the Silk Supply Association, for the purpose of more effectually carrying out its objects. An attempt to cultivate the *Bombyx mori*, or true silk-worm, in England, is proposed to be immediately undertaken, and a speedy revival of silk culture is confidently anticipated.

THE MARKET SYSTEMS OF THE COUNTRY, THEIR USAGES AND ABUSES.

The wide margin between the home prices of fruits and vegetables, the grains and meats of the farm, and the rates at which they are sold to city consumers, is often suggestive of extortionate combinations and oppressive regulations and usages, by which greed obtains a large portion of the reward of labor. While the laborer who carries the produce of the farm to the city larder is as worthy of his hire as the husbandman himself, there is opportunity for oppression in the fact that the market men and hucksters of the city are voters of the municipality, and the selfishness of human nature in such a contingency usually involves municipal regulations in some degree unjust and burdensome to the original producer. Where farmers are permitted equal opportunity with hucksters to sell in open market, there can be no ground for censure of city dealers.

The usages and regulations of different markets are so diverse that it has been deemed a matter of much importance to examine in detail the peculiarities of the systems in vogue in the principal cities in the country, with the hope and expectation that the better features of the best-regulated markets may ultimately secure general adoption. It was believed that a general reform in our market system is required, and that by taking wise and proper steps such reform could be inaugurated and carried to gratifying results. The first step was to arrive at a complete statement of these objectionable usages or customs in the food market; and with that view a circular was sent from this Department to a number of persons who, from their official or editorial position, were likely to be possessed of the information sought, asking information upon the following points:

1. Number of days in the week and hours of the day in which farmers are permitted to sell from their wagons.
2. Amount of space at the market-houses and on the streets which they are allowed to occupy.
3. Prices obtained by middlemen or hucksters, compared with the rates allowed by them to producers.
4. The bearing of prevalent usages of commission-men upon the interests of producers.
5. Amount of license (if any) required of farmers, and other municipal restrictions or requirements in regard to their sales.

The result of this request has been the appearance of articles in the leading journals of our cities reciting the various abuses to which housekeepers are subjected in purchasing provisions.

The Department is also in receipt of long and in many cases carefully prepared reports of the market systems of our cities, and of public documents, as charters and market ordinances, and in some cases extended historical statements of the gradual development of systems to correspond with the growth of cities. This mass of material has caused some embarrassment from its bulk and from the difficulty of establishing any system of presentation that would avoid a wearisome repetition.

MARKETING IN CITIES OF LESS THAN 100,000 POPULATION.

The difficulties of supplying the smaller cities with various articles of food are not serious. From some, Albany and Norfolk, for instance, no complaints have been forwarded. In Albany the farmers drive into town in their farm wagons, and the only city usage that affects them is one that requires the broad and beautiful street where they stand to be cleared by 11 o'clock. The sales are made direct by the farmer to the families or storekeepers, generally through the agency of runners, who earn a small commission where produce is sold in quantity.

The plan and geographical position of towns have much to do with market usages. Albany has the least cause for complaint of any city which has answered this circular. It is surrounded by a fine farming country, the estates extending to within a mile in some directions of the street where the principal sales are made. That street is so broad and the grade is so steep that making a market of the center of it does not lower its tone or detract from its healthfulness as a place for residences of the first class. On the other hand, cities like Newark, New York, and San Francisco, that are separated from farming communities by arms of the sea or by marshes and rivers, report the most objectionable usages. Mobile also, built on a peninsula between a river and an arm of the sea, with a wide interval of marsh and barrens separating it from productive lands, complains of the unrighteous profits exacted of the consumer by

middlemen and hucksters. In Mobile and Charleston these hucksters charge from 100 to 200 per cent. advance. In Norfolk the advance is quite reasonable, being on an average not over 20 per cent. beyond the sum paid the producer.

In most cases it has not been found practicable to regulate the relations between the farmer and the city consumers by ordinance. Rules have been made in some instances prohibiting the sale to hucksters, but they are either avoided by a subterfuge or have become dead letters on the statute-book. The rapid growth of our cities, especially of the manufacturing cities, where a majority of the operatives are of foreign birth, will of itself account for many of the abuses complained of. Suppose, for instance, that Albany, which has as good market usages as any town of its population in the country, should grow to be a city of 150,000 or 200,000, and that a majority of the accession were from the hard-working class, natives and foreigners. The street where now nine-tenths of the food of the towns-people are bought directly from the farmers would be found remote from the new and densely settled parts of the city. To supply them, the potatoes, cabbage, carrots, veal, eggs, and milk could not be raised within easy driving distance. The railroads would be extensively used. The farmer would not find it practicable to come with his produce; the middleman would become a necessity, and it would be for his interest to drive the producer away from the city, which could be done by some ordinance made in the hucksters' interest. Of the farmers who have for years been standing on Capitol Hill, some would prefer the quiet of their farms, and sell their market-wagons; some would prefer the bustle and possible gains of the city, and become hucksters. This is substantially the history of market usages in our towns, when they reach and pass a population of 100,000. In all towns of less size, however, a study of the market practices has convinced us that there is no difficulty in securing direct trade between the farmer and the consumer. The very hands that dropped and dug the potatoes may measure them out by the bushel or the barrel at the door of the merchant, the lawyer, and the capitalist. All that is required to secure this end is combination and coöperation on the part of the farmers, followed by city ordinances, so framed as to promote this direct traffic, rather than to discourage farmers and throw the food supplies into the hands of middlemen and hucksters.

MARKET SYSTEMS OF LARGE CITIES.

As above indicated, when a place returns a population of about 100,000, from the nature of things, the length of streets, the enhanced value of lands near the city, the influx of crowds indifferent to the quality of their food or ignorant of the characteristics of sound meats and fresh vegetables, the market usages undergo a change, and the problem of furnishing great metropolitan centers with food in abundance, on moderate terms, becomes one of the first practical importance. A market-house and a market system that were exactly adjusted to the wants of a city of 60,000 or 70,000, grow yearly more inadequate as the population swells to 130,000, 150,000, and to higher figures. Boston furnishes a notable instance. In 1825, when the corner-stone of Faneuil Hall Market was laid, the population of Boston was somewhat less than 60,000, mainly included within a circuit of a mile. The surrounding country was thinly populated, and was devoted chiefly to agriculture. Fruits and vegetables were raised in abundance within an hour's ride of the market by wagon. Vermont and New York furnished all the roasts and steaks the Boston tables required. Now the territory that was occupied

by 60,000 persons shelters over 200,000, and the population of the city and of the towns that are practically suburbs and inhabited mainly by merchants and artisans is about 650,000. The business at Faneuil Hall Market, at first retail, is now chiefly wholesale and jobbing. It is the great provision exchange for New England. Not over 2,000 out of 50,000 families go there to market. They buy at second-hand of corner grocers. There are 739 such shops now, and there were but 330 in 1851, showing that the corner-grocery system is increasing faster than is necessary to keep pace with the population. The prices at these shops are higher than at Faneuil Hall, but the difference is not excessive, and can be kept moderate if the citizens will but inform themselves of Faneuil Hall prices, and show a determination to go there rather than to pay more than an equivalent for the loss of time in going to a more distant market.

The market system of New York closely resembles that of Boston. Of public markets there are fourteen, of which the principal are Washington, West Washington, Fulton, Center, and Tompkins.

Designed originally as a series of stalls and stands, where the merchant or other citizen, with basket on arm, could meet the farmer face to face, the business has expanded so enormously that the good-will of some of these stands is worth from $10,000 to $50,000, and there are many which cannot be purchased at all. Men who have built up a business and prospered by it do not care to remove and thereby enable the market officials to dispose of the stand for a large sum of money. There are marketmen who hire stalls and do not occupy them, preferring to do business outside, but to retain possession of their stands, thus preventing other persons from getting them.

The practice with farmers is to gather around the market with their wagons as early as 9 o'clock in the evening of the day preceding that on which they expect to sell their produce. They must take their position in regular order and pay their fees, when they remain unmolested. When the market opens in the morning, the producers may deal directly with hucksters if they wish, or they may, if they do not care to wait, put their goods in the hands of middlemen, who, for a commission of 10 per cent. for perishable articles, of 25 cents per barrel for potatoes or apples, will sell this produce for them and make returns. Sometimes it is advantageous for the producer to dispose of his articles through the commission merchant, especially when the market is glutted, or when he may be unable to be present in person. The producers and hucksters can remain in and around the market as long as they please, the old rule requiring them to leave at 12 o'clock noon being now obsolete. Producers can, if they desire, sell to any other person than a huckster or commission merchant outside the market, and can deliver goods to hotels or private houses if they wish.

As buyers of food, the population of New York can be divided into three classes. There are the upper 20,000, who live in five-story brownstones, and spend from $5 to $10 daily in the purchase of perishable food and as much more for pantry articles. For such, nearness to a market-house is a prime necessity; hence the steady increase in the number and neatness of outfit of grocers' and butchers' establishments on or near fashionable streets. The proprietors of these go to Washington, West Washington, and Fulton, as wholesale houses, and take the cream of all that comes, the tenderloins, the fat chops, the finest chickens, the fattest turkeys, paying well and expecting their customers to pay better. In New York and Brooklyn there are 100,000 families that buy liberally and intend to have good food, but always with more or less regard to economy

and thrift. For such, the market accommodations of these great cities are wholly inadequate. Half an hour is consumed in going and another half hour in returning from the markets where good articles can be had at moderate prices. The alternative is to pay a dollar beyond the proper value of a marketing at a fashionable stall where meats are good, or to buy at a third-rate stand, where the million go, where the vegetables are wilted, the chickens are blue, and the beef Texan.

Philadelphia has for generations been noted for the excellence of its market system. There is a law in force providing that vegetables, provisions, or fruits, exposed for sale shall not have been previously purchased within the limits of the city. When the city erects a market-house, one-half of the building remains free for the use of the country-people attending the market; and no fees, tolls, or perquisites are to be exacted from them for the use thereof. Persons who send or carry the produce of their farms to market may sell beef, mutton, &c., slaughtered on their farms; and persons so selling such meats, &c., are not liable to any fine for selling in less quantities than one quarter; provided that farmers using the stalls in the market-houses for such purposes shall pay a rent or compensation for each stall not exceeding $20 per annum. The select and common council annually elect a "commissioner of market-houses." No person is allowed to sell or expose for sale elsewhere within the market limits than in the stands specially provided therefor any fruits, vegetables, or other provisions (except fresh fish, meal, or flour) which have been before purchased within the city of Philadelphia. No person exercising the trade of a butcher is permitted to occupy a stand or station without the market-houses free of rent; and no person is allowed to offer for sale any veal, beef, lamb, &c., unless the same is the produce of his or her own farm, upon any of the streets authorized for the stands for market-wagons, under a penalty of $20. The stalls and stands within the public market-houses, and places for the use of which rent may be lawfully charged, are let annually. No person is allowed to use steelyards or spring-balances within the market-houses. No person, except farmers bringing the produce of their farms to market, is allowed to sell or expose for sale any butcher's meat in any streets or other highways of the city south of Lehigh Avenue, east of the river Schuylkill, or north of Morris street, in any cart, wagon, &c., nor carry about the same for sale.

In consequence of the execution of these regulations, the second city of the Union has better marketing than some towns of one-fifth her population. On Wednesdays and Saturdays, in the afternoon, thousands of pounds of butter, poultry, meat, and sausages are sold to consumers by farmers from Delaware, Chester, and all the counties within thirty miles of the city. Their butter-tubs are larger and handsomer, the balls are fairer and more golden, than are to be seen in any other city. The market-houses of New York are musty old rookeries, and those of Baltimore are sheds, compared with the elegant, cleanly, sweet-smelling, though expensive, buildings in which the Pennsylvania farmer meets the consumer face to face.

The cities which grow most rapidly are found to adopt or to allow usages which will, no doubt, be corrected as business crystallizes into permanent forms. Thus, Chicago gives the common council the right to license private meat and fish shops. The result is, that marketing stalls are scattered promiscuously over that most vigorous and thrifty metropolis. Next to a great hardware-house you buy a roast, and the latest novel is side by side with white fish caught in Lake Superior.

The mischiefs of a bad market system are aptly illustrated by the re-

port we have received from San Francisco, a city on a peninsula, and built with great rapidity, and without a knowledge of the probable magnitude it might reach. Our correspondent's letter is given at length, as much because it illustrates the evils that exist in a form less aggravated in other cities, as because of the clearness of his statement:

San Francisco is situated on the end of a peninsula, much of which, especially that part near the city, is unfit for cultivation. The fertile plain of Alameda is only five miles distant, on the eastern side of the bay, but the farmers seldom take their wagons across in the ferry-boats, and the consumers get nearly all their fruit, and a large part of their vegetables, from middle men.

Living in San Francisco is dear, and all the commissions and profits are high. The commission merchants who receive butter, cheese, eggs, fruits, and vegetables from the producers in considerable quantities, and sell again in large quantities, with very little handling, charge five to eight per cent. There are jobbers who purchase such articles in bulk from the producer, and make ten to twenty per cent. profit. They must have pay for the risks they incur, the capital they invest, the time they spend in examining the merchandise, and the labor they devote to assorting and taking care of it. The producers who send their produce to commission merchants get more on the average by ten to fifteen per cent. than those who sell to wholesale dealers, but they also incur risks, for the commission merchant will not incur much trouble to prevent perishable articles from spoiling, and will not spend anything in forcing them on the market. Fruit, after re-assorting and repacking, can often be sold for twice as much as it could be without; but the commission merchant will not do the work, because his principal would object to the expense. In the packing of all kinds of fresh fruit there is need of improvement. The grapes from certain vineyards, pears and apples from certain orchards, simply because of better selection and packing, bring 25 to 50 per cent., and in some cases 100 per cent., more than others that were equally good when on the trees or vines.

The retailers of fruit, vegetables, butter, cheese, and eggs generally purchase of commission merchants, and sell at 25 to 100 per cent. advance. The more perishable the article, the higher the profit on good lots, to compensate for losses on bad lots. On kitchen vegetables, sold in small lots, grapes, berries, and very soft kinds of fruits, the profit is 100 per cent. On fresh butter the retailers generally make 10 cents per pound.

Most of the gardeners near San Francisco are Italians, who bring in their vegetables every night in two-horse spring-wagons, with loads piled up four to six feet above the top of the wagon-bed, and kept in place by ropes or canvas. The sales commence about five o'clock, and at eight the wagons have disappeared, and the street is closed up. The stewards of hotels and large boarding-houses, the retail-market men, and many of the poorer class of housekeepers, purchase at these wagons, where they get their vegetables cheaper than in the market-houses. Those gardeners who are not Italians usually send their produce to commission men, who charge 8 per cent. commission.

Beef and mutton are furnished to the San Francisco market chiefly by a few butchers, who own considerable areas of pasture land near the city, and buy up great numbers of cattle. They agree on the prices to be charged for beef, and before the completion of the Pacific Railroad small dealers accepted their prices, but the markets have been affected by the receipts of beef slaughtered in Wyoming Territory and shipped in a frozen condition in refrigerator cars to San Francisco, where it is sold at 8 to 10 cents per pound, when the California beef would otherwise sell for 12 or 15 cents. The Wyoming beef is tender and juicy, but does not keep long. The game and poultry are sent to agents, who charge 5 to 8 per cent. commission, and sell without delay to the retailer, seldom moving the articles from the wharf where they are landed previous to sale. The retailers usually make 25 to 50 per cent. profit.

There is no fixed rule for the profits of retailers of fresh provisions; they depend on the conditions of the merchandise, the amount of the stock, and the urgency of the demand. A hot day, which hastens fermentation or putrefaction, a heavy rain, which prevents housekeepers from going out, an unexpected arrival of a large lot of fruit or beef, the detention of a train or steamer with an expected supply, may cause a rise or fall of 20 to 40 per cent. in prices. The general rates of profits of middle-men in San Francisco may be summarily stated thus: Nearly all the fruit, dairy produce, game, poultry, and a considerable part of the vegetables sold in the city pass through the hands of commission merchants, who charge 5 to 8 per cent. commission.

Some of these articles are bought from producers by jobbers, who make 10 to 20 per cent. profit. The retailers buy their fruit and dairy produce of commission merchants or jobbers, and charge 20 to 30 per cent. profit on butter, cheese, and eggs; 25 to 40 on apples and hard pears, and 40 to 100 on peaches, soft pears, apricots, grapes, berries, &c. The green vegetables they buy generally of the producers, and sell at an advance of 100 per cent.

Of one dollar paid by the consumer, the producer generally gets 70 cents on butter, cheese and eggs, 65 cents on apples and hard pears, 35 to 45 cents on soft fruit and berries, and on green vegetables 50 cents. Out of this he must pay the freight to the place where the fruit sale is made in the city, provide the packages, pay return freight on them, incur all the expenses of picking and packing, and all the risks of loss previous to the first sale.

The retailer who has a stall 20 feet square in the market, or a shop 20 by 60 feet, sells all the produce of two dozen orchards and gardens, covering an area of several hundred acres, and receives as much for the labor of himself, one clerk, perhaps, and a teamster, who delivers his merchandise to the consumers at their houses, as the two dozen orchardists and gardeners. The retailers do not get rich, but they live with more ease and in a more expensive manner than the farmers who have done the chief work, furnished most of the capital, and incurred all the risks. The producers get little, the consumers pay much; the middlemen take the bulk of the profit. No orchardist or gardener has his own retail establishment in the city, nor is there any coöperative association of any class of agriculturists to sell their produce, except in the wine business, and that partakes of the nature of a manufacture.

Middlemen are and always will be indispensable, and they must be paid. The farmer may carry his produce to the house of the consumer, but then he becomes a middleman for the time; the consumer may go to the garden to make his purchases, but he, too, becomes a middleman. Producers and consumers generally cannot meet, and the transactions between them must go through the hands of others. But the number and the profits of middlemen are disproportionately large, and as they contribute nothing to production, and are burdens on the producing classes, it seems to be the interest of the general public that they should be reduced as much as practicable.

It seems impossible, however, to make any reductions without departing from principles of business sanctioned by custom and long experience. We have in San Francisco five large market-houses, each of which has five to ten small stalls where vegetables and fruits are sold. One large stall could do all the business at less expense; but if the proprietor of this large stall could drive out all the little ones, instead of making fruit cheaper for the consumer he would probably charge them the same price, and put the profit in his pocket. Even if he should promise to reduce the price to the consumer and increase it to the producer, we would fear to give him the monopoly of the privilege of selling fruits and vegetables in that market and in its vicinity. It is evident, however, that the only improvement must come from a reduction in the number of middlemen, systematizing their business, and holding them to account.

Our laws permit, and public opinion encourages, coöperative movements; but in fruit and vegetables, which differ greatly in value when first fit for market and are seriously injured by delay and carelessness in sending to market, coöperation is beset by serious obstacles, yet it might no doubt be managed with success, and it seems to be our chief hope for a decrease of the evils which accompany the present method of placing farm produce within convenient reach of the consumers.

Many frauds are committed by the agents who receive provisions for the San Francisco market on commission, in misrepresenting the prices and reporting stocks as spoiled and unsold, when, in reality, they have been sold in good condition; but these frauds seem to be beyond reach, as a class, as long as the present system is maintained and men are dishonest.

The only municipal regulations of San Francisco affecting marketmen are those fixing the licenses which they must pay. Peddlers of provisions selling from wagons pay $20 per quarter for each vehicle used; venders in market-houses pay $1 per stall per quarter. The city has no market-house or market-square, and, although large quantities of vegetables are sold from wagons which occupy stands in the street, no ordinance authorizes them to occupy any street or fixes the times at which they may sell or at which they must move. Sansome street, near Washington, is crowded every morning, from five to eight o'clock, with wagons laden with kitchen vegetables, and with the purchasers, but the marketmen get permission to occupy their stands, not from the city authorities, but from the owners of the lots fronting on the street. Sansome is a narrow street and has no advantage for the marketmen, except that the business is established there.

The mischiefs of a false system of distribution are admirably illustrated in this clear recital of our correspondent on the Pacific slope. The practical result is that 10,000 bushels of pears fell to the earth and rotted in the orchards of Santa Clara, or were thrown by the bushel to the pigs, while the price of a pear on a street-stand in San Francisco, 50 miles distant, was five cents. The small farmer on the plains of Alameda is discouraged because he can get nothing for what he raises, and the small shopkeeper in the city across the bay is discouraged because his gains are frittered away in unjust profits at the market-house.

These evils do not appear to be so serious in any other seaboard city of the East as at Newark. This place has a population of 110,096, the majority of whom are artisans and laborers, who earn about four dollars a day. The great metropolis, ten miles away, draws everything, and gives its citizens the first cuts of beeves, the fattest of the chops, and the largest peaches. The farms on one side of Newark may be able to supply the cabbages and beets, the lettuce and tomatoes required, but in the weightier items of family expense, as bread and flesh, our correspondent, who gives a chapter of Newark grievances, enlarges as follows:

A hundred-weight of the best flour ever baked costs, at the mills along the Central Railroad of New Jersey, $3 50. This is the retail price, either by the hundred-weight or by a 25-pound bag. The average freight from any wheat-producing district in the State, including cartage from the depot, does not exceed 20 cents per hundred. Commission men say they receive about 5 per cent., and sell to storekeepers for $4. But what becomes of the miller's deduction for wholesale rates? The storekeeper sells nine-tenths of his flour in small bags, weighing 25 pounds each, at the rate of 5 to 6 cents per pound. Thus the difference in the price of flour in Newark and places 25 miles distant is $1 50 to $2 50 per hundred-weight; that is, from $3 to $5 by the barrel. But very excellent flour can be bought of some dealers for $8 per barrel, while an inferior quality sells for $6 50. Unfortunately, mechanics and laborers do not always have the money to pay for a whole barrel of flour, and must divide their week's wages among the different articles needed. A class of dealers buy flour by the barrel, and put it up in paper bags, on which is printed "Best Family Flour." The unsuspecting housekeeper purchases this. Sometimes the commonest sort of low-priced stuff has been palmed upon her. This abuse has grown so common, that purchasing one of these bags is like buying a "pig in a poke." A flour dealer in Elizabeth, a village of 10,000 people, says that, when he was in the grocery business in Newark, he bagged $3 50 flour and sold it for $5, but in his present locality and business he dare not do it. A man who had lived in Warren County stepped into a Newark grocery store to buy some buckwheat. The price was $4; at the next store, it was $5; at the next, $6.

Dairymen receive four cents per quart for milk shipped per rail to Newark. It is retailed for ten cents per quart; freight, one cent per quart.

Farmers sell potatoes by the bushel or by the quantity at $1 per bushel, while grocers sell them at $1 40. Last spring, while they were carted around the streets of Rahway, nine miles distant, for 45 cents, we paid at stores $1, and often got the meanest kind at that. Tomatoes, sold by farmers for 50 and 75 cents per basket, cost consumers, at some stores, $1 to $1 20. Peaches are sold by middlemen at whatever they will bring, large quantities being retailed at the rate of $3 per basket, for which the farmer received about $1 25. Of butter there is no general complaint, the price being reasonable and the quality good, yet at country stores within an hour's ride of Newark it has been ten cents per pound lower than here, and of superior quality. Eggs bring from 5 to 10 cents more per dozen than in the surrounding villages; but, on the principle that old wine is better than new, they are worth more, especially with an occasional spring-chicken in the shells.

Our meat trouble commenced with the war. The supply comes chiefly from the Communipaw cattle-yards, the whole number of cattle and sheep fitted for market in New Jersey in a year not being sufficient to supply the city of Newark for a month. During the war some operators bought up all the cattle they could lay their hands on, shipped them to Albany, and dribbled them out at their own prices. Afterward they were taken to New York and sold at auction to jobbers, who sold them to slaughterers, who sold them to middlemen, who sold them to consumers at a precious price.

This illustrates the way in which beef has reached consumers in our market ever since, though of late the increasing supply of cattle has a tendency to break up this business. The difference in price between beef and mutton has narrowed down to a nominal sum, beef having slightly declined and mutton reached unwarrantable figures; while, no matter what the charges at the drove-yards, there is little or no variation in the price charged customers. Butchers, who are believed to sell the best beef, say they buy no low-priced stock; that they pay from 13 to 16 cents per pound net weight for cattle on the hoof, kill and sell the carcass to middlemen for the same, or less, per pound than they give, taking the hide and tallow as profit. Beeves are scaled at from 50 to 57 pounds per hundred-weight; that is, for every 100 pounds live weight, 50 or 57 pounds of meat are counted. They say that of a carcass not more than 30 pounds per hundred-weight can be sold at an advance. Yet there is no part sold, except a very small portion of the neck and shins, for less than 15 cents per pound, and

the price paid by middle-men during the past summer has seldom been more than 14 cents. Purchasers know that they cannot buy a roast or fry for less than 25 cents, and often it is 28 to 35, while the poor cuts are sold for 15 to 22. While our respectable butchers will sell nothing but good meat, others are constantly on the look-out for low-priced cattle, poor, miserable, lean, stringy, diseased, over-driven beasts, whose quarters are cut up in the cheap meat shops, the best roasts and steaks selected out for low-priced eating houses, and the remainder sold, at whatever price can be had, to that class of people who inhabit the dirtiest portions of the city. These slaughterers also buy up all of the bob calves and sickly sheep within their reach.

Farmers who have slaughtered sheep say that such as bring the highest prices will dress 60 pounds per hundred-weight. Some time since 10,000 sheep sold at Communipaw at an average of $4 each. One pelt is as good as another, and the price fixed was 80 cents each, bringing each sheep down to $3 20. Suppose each dressed 50 pounds per hundred-weight, and was sold to the middlemen for 12 cents, then there would be nearly $3 per head or 100 per cent. profit to the butcher. Put the price at 10 cents, and we have 50 pounds for $5, or $1.80 advance for the butcher. In vain may it be said that thin sheep will not bring these prices; the thin sheep only cost 4 cents per pound, and when nicely dressed with inside adipose from fat sheep delicately twined around their clean legs, why, then, a leg of mutton is a leg of mutton and sells for 25 cents per pound. A mutton has two legs which will weigh, say, 5 pounds each; amount $2 50; sell 12 pounds of chops for 20 cents, $2 40, and the remaining 28 pounds at 12 cents, $3 36, and your sheep amounts to $8 26. Cut and carve as we will, meat costs money.

Take it the other way. The Newark retail-market quotations fix mutton at 14 and 18, or 16 cents average. If the middleman paid 10 cents, he made $6 on 100 pounds, or 60 per cent. If he paid 12 cents he made 33⅓ per cent.

There may be a slight variation from these figures, prime sheep selling at 6½, but they dress over 60 pounds per hundred-weight, and more than make up the difference.

Grass calves sell at 4 and 6 cents. These will yield at least 60 pounds of meat per hundred-weight. Allowing the butcher the skin for the trouble of taking it off, the carcass costs him $5. Sold at 15 cents per pound, it brings $9, or 80 per cent. above cost. If it cost more than grass calves, let the difference go against the poor little things bought up by thousands from milkmen at $1 per head. On calves for which butchers now pay an average price of 10 cents per pound, and which are sold for 18 by the carcass, the profit is not so heavy, but the few that cost 10 cents are mixed with inferior ones, which reduces the average; besides, calves bought at the highest price will dress heavier than poor ones. Calves carried a long distance in the hot sun, with their legs tied together, become fevered and make unwholesome meat. We have seen them tossed into a cart, hauled five miles, and thrown on a station-platform to lie seven hours, with their legs doubled, the cords cutting to the bone.

It is due to the butchers of our city to state that among them are to be found many honorable, fair-dealing men, who, though they follow the fashions and fix great prices, give us some of the most juicy, tender, and excellent beef and mutton to be found in any market. They have their backsets and lose heavily by those who buy on credit. Newark is deficient in market accommodations. The rapid extension of the city seems to demand some change, as two-thirds of the population are now compelled to travel one to two miles, or depend upon exorbitant shopkeepers for their supplies.

While the reports from San Francisco and Newark indicate abuses which are sufficient to arrest general attention, some cities, more conveniently situated as centers of great producing districts, make little or no complaint. Cincinnati, for example, gives the following brief summary, and the accounts from St. Louis are similar:

Cincinnati markets are open each week-day from dawn till 10 in the morning in summer, and from 6 to 11 in winter. Certain convenient stands the farmers are allowed to occupy with their wagons, and expose what they have for sale. Hucksters are each required to pay to the city a license of twenty dollars a year. Farmers pay no license, and are subjected to no special restrictions, our usages encouraging the largest freedom of direct traffic with the producer. The markets are under the supervision of market-masters appointed by the city. There have been periodical complaints of the combinations of hucksters and middle-men by which prices were exacted from the consumer out of all due proportion to those received by the producer. We hear little of this matter of late, and such investigation as we have instituted has as yet failed to disclose any glaring discrepancy between prices in the city and in the country. Our market system appears to be working smoothly, and, for aught that now appears, it gives general satisfaction.

In Buffalo, hucksters make about 25 per cent. profit on produce bought from farmers, and the correspondent thinks the middlemen a useful class, because they enable the farmer to sell out early and get back to his farm work.

In Louisville, corn, hay, oats, and potatoes are sold by farmers directly to consumers; fruits and vegetables are sold to numerous hucksters, whose profits range from 25 to 50 per cent. Their agency is counted an advantage also, as the farmer can sell out quickly and save much time.

THE MEAT SUPPLIES OF GREAT CITIES.

Counting the cities and villages near New York as parts of the great metropolitan center, the problem daily presented to the railroad men, the drovers, and butchers is, how are two millions of persons to obtain their supplies of good, wholesome flesh, when the center of the flesh-producing region is 1,000 miles distant and steadily receding westward? Nor is the victualing of New York alone the extent of the task. Within twenty miles of Boston there are 650,000 persons that must depend mainly for flesh upon grass and corn farms west of the mountains.

The people of Philadelphia are fed to a great extent in the same way, but the fine farming region north and west of that city does a great deal toward her meat supply. Baltimore and Washington receive their beeves from West Virginia, from the Piedmont counties of Virginia, from the northern part of Maryland, and from Ohio, by way of the Baltimore and Ohio Railroad. A careful estimate of the population of the eastern cities shows that about four millions of people must receive their meat by car transportation, and that three-fourths of such meat must be carried a thousand to twelve hundred miles.

What is the present method? The Union stock-yards of Chicago are an immense gathering ground of animals from Illinois, Iowa, Missouri, Kansas, and Kentucky. They are owned by a joint-stock company, with a capital stock of $1,000,000, the most of which is held by nine of the leading railroads that concentrate in that city.

The premises of the company comprise 345 acres, 120 of which are covered by 500 pens, ranging from 25 by 35 feet to 85 by 112 feet. Fifty additional acres are devoted to hotel and other buildings, leaving 175 acres for future use. The pens will easily contain at a time 25,000 head of cattle, 100,000 hogs, 50,000 sheep, and 350 horses in stalls.

The whole yard is underlaid with drains that discharge into a sewer. Each of the 500 pens is floored with 3-inch planks, laid a short distance apart, on sills raised from the surface of the ground; the yards are thereby kept dry. Unlike the plan at Communipaw, of placing the hogs and sheep under a single roof, there are 20 acres covered by one-story pens for sheep and hogs. These are open a foot or more from the roof, and are separated from the outside world by a board fence, which does not furnish the best protection from storm or cold.

The yard is divided into four parts by two streets crossing at right angles, and these parts are so subdivided that each drove can be separated into companies of fifty by driving the animals a few rods. Each of the principal railroads has 1,000 feet of platform with chutes leading into little yards that will hold a car-load, and these again empty into other and larger ones to suit the convenience of the drover. There are six barns on the ground, each of which will hold 500 tons of pressed hay, and six corn-cribs, each of which is ample for 6,000 bushels of corn on the ear. The yards are supplied with water by an artesian well, 1,190 feet deep, and the water is carried from the surface of the ground into five immense tanks, set 25 feet above the ground, and then is distributed where it is needed. A hotel and bank are on the premises. Comparatively few cattle are slaughtered here. Most of them are brought in by droves and put into the hands of a broker who sells them to eastern and southern buyers, always by weight, for which

service the drover pays 50 cents for each bullock sold and perhaps one-tenth of that sum for each hog or sheep, and 25 cents each as stock-yard fees on cattle, and 8 cents on hogs and sheep. The buyer pays for the cattle before they leave the yard. They are then driven through the chutes into the cars for transportation to their destination.

In 1870 the total number of each class received was: Cattle, 532,964; hogs, 1,693,158; sheep, 349,855; horses, 3,537, a large proportion of which remained but two or three days before reshipment. Only a part of these animals, especially the beeves, are fit for the butcher when they leave Chicago. Many are taken to the great corn-growing regions of Illinois and Indiana, and fed for several months. Ohio fattens a large number. Many of these animals come back to Chicago when they are in condition, and are taken to the eastern consumers by cattle trains. The abuses on these cattle trains have arrested the attention of public-spirited men and humanitarians, and much has been urged in journals and before the Society for the Prevention of Cruelty to Animals, but with so little effect that meat in the markets of the great eastern cities has not materially improved either in quality, wholesomeness, or cheapness. When a beef is driven up a chute and forced into a cattle car, his worry begins. He is jammed against other beeves, he is alarmed and irritated, sometimes his temper is soured, and he begins to gore right and left in the hope of fighting his way to freedom. Then begins the strange alarming motion of the car, the jostle and the roar. From protracted fear and apprehension, the condition of the heart changes; the system becomes feverish; he loses appetite; and sometimes, though consumed with thirst, he is too much alarmed to drink. The result is, that a thousand miles' ride takes 100 to 500 pounds of flesh from an animal; and he is in a jaded, sore, and feverish state when the butcher's mallet puts an end to his long misery.

A law has been proposed requiring the cattle trains to stop and let the animals have rest and pasturage two or three times on their way from Chicago to the sea-board cities. This would not amend the mischief. When an animal has suffered from this fright and fever of rail car transit, a rest of 24 hours does him little or no good. He is dull and lumpish for a week. He is turned into a strange pasture where he meets new grasses, and at first he does not relish them so well as the prairie growth. It will be three weeks or a month before he begins to gain in flesh, and then he fattens very slowly. In addition to the loss by emaciation, a third, and often a half, of the cattle that reach New York, especially those coming by the Erie railroad, are badly bruised. When a car is narrow, and some care is taken, the animals pack with greater comfort to themselves than in a wider inclosure. Erie is broad-gauge, and the animals, taken at furious speed down heavy grades and around sharp turns, are jammed against each other, and those on the outside are dashed against the sides of the car with such force that a large bruise will be found to extend quite through the flesh between the ribs, and the meat looks yellow and livid, and is quite unfit for food; yet bruised quarters are sold every day by the hundred in Washington market. It retails at two or three cents below the price of sound meat, and the loss from this source falls mainly on the wholesale butcher, because no examination of the bullock will disclose the condition of the flesh beneath the skin. In the summer of 1870 these and similar abuses in New York stock-yards were the subject of investigation by a committee of the Farmers' Club of New York, and their report thus recites a series of neglects and brutalities:

There is great indifference on the part of drovers and proprietors of the yards to the

health and comfort of the animals under their charge. Generally, no covered sheds are provided for horned cattle, and the yards contain no adequate convenience for the accommodation of cattle unloaded from trains in a fatigued condition after long travel.

In hot weather the supply of water is insufficient, the troughs are foul, and the water muddy; in severe winter weather the troughs are frozen over, and the cattle are forced to lick the ice or to eat the frozen snow to partially satisfy their thirst. Dry hay is the food furnished in all seasons. The cattle-pens are filthy and unwholesome. Fat cattle are exposed to extreme suffering in hot weather, and fat bullocks have been seen lying at full length on the floor with their tongues lolling out of their mouths, no water being given to them nor any thrown on their heads.

In extreme winter weather, light steers, coming from the cars bruised and crippled, and unfit to withstand the cold, are exposed to great suffering; their tails become frozen for several inches, and icicles depend from their flanks, ears, and beards. In wet weather the pens are filled with filthy slush, emitting foul and deleterious vapor, and steers have been dragged out from this slush and their throats cut to prevent death by suffocation. These facts indicate that the cattle slaughtered for the consumption of the city are, to a very great extent, in a feverish condition, and consequently unfit for human food. The sheep-houses are protected from the weather; but the sheep and lambs confined in them are always overcrowded, and when changed are badly treated and over-driven, and when put on the scales are packed so closely as to be unable to stand. Hogs receive the grossest treatment, and their pens are very filthy.

Mr. Bergh, in his report for 1869 on cruelties to animals, states that it has been his practice to visit the great cattle depots of the city during the winter, choosing the most inclement days for his visits. In one yard, situated in an elevated part of the suburbs, wholly exposed to north and west winds, and totally unprovided with shelter, were hundreds of animals, some of them coated with ice, the result of a snow-fall which had partially melted and had again become frozen. Mr. Bergh urges the passage of a law restraining these cruelties, with provision for an inspector of cattle-yards, with necessary assistants, and with authority to arrest any butcher slaughtering crippled or exhausted animals.

A visit to the abattoirs, and conversations with the large butchers of Washington market, some of whom handle a thousand quarters in a day, have convinced us that the abuses above described and the slaughtering of sick and battered bullocks are on the increase. One dealer says that he buys lots that come on the Erie railroad in which one-third of the bullocks have great livid and yellow places on their loins and ribs. He has customers with whom the reduction of one or two cents per pound will always secure the sale of this unwholesome meat.

It is doubtful whether any legislation on the transit of live-stock will cure the mischief. The difficulty is, to a great extent, in the nature of things, in the configuration of the continent, in the fixed laws of climate. The region where the fattening grains can be grown in great quantities and with profit begins at a line drawn south from Cleveland and extends to the middle of Kansas and Nebraska. Illinois, the great corn State, is in the middle of this magnificent belt. The boundary between the corn lands and the grass lands is not sharply defined, but none of the pioneer settlers think corn can be raised in quantity and with profit west of the mouth of the North Platte. But the immense region west of this produces an abundance of hardy, nutritious grass, on which animals can live and grow, and often become quite fat. The natural course of pastoral agriculture in such a country is, that the grass belt should produce the cattle, and the corn belt should finish them and fit them for the knife. This is now, to a great extent, the course of business. Those who have brought grass-fed beeves from the great plains directly to the eastern cities have seldom made anything in such trade, and many have lost largely. There is no difficulty in bringing the animals as far east as the great granaries. The real difficulty to be solved is, how to bring corn-fed beeves from the Mississippi, the Ohio,

the Illinois, and the Wabash to tide-water cities. An attentive consideration of the subject, and conversation with the beef merchants, have convinced us that the true line of improvement lies in the direction of *a well-regulated beef express* from Chicago and St. Louis to New York, Boston, Philadelphia, and Baltimore. There are two ways in which such express can work with profit. By the use of padded cars, made expressly for the purpose, with movable partitions, each animal can stand in one place without being jostled, horned, or kicked by his fellow prisoners. If, in addition to such improvement, the cars can be rolled at a rapid and uniform rate, say at an average of 15 miles an hour, fat and gentle beeves can be taken from regions where corn is 40 cents a bushel to cities where steaks are 30 cents a pound, and in this industry there is much profit for the drover and little suffering or loss of weight for the animal.

By inventions and improvements, in which each year sees important advances, dressed meat can be taken from the Mississippi to the great cities with very slight decline in quality. The inventors in this line are required not merely to produce a chamber of low temperature, but a dry atmosphere. It is found that meat in an atmosphere of 60° to 70° that is dry retains its flavor and sweetness much longer than if held at 35° or 40° and then exposed freely to the water-laden air of tide-water towns. To secure an abundance of wholesome and cheap meats to all the inhabitants of the Atlantic slope, a system, something as described in outline below, is demanded. The animals should be collected, as required in eastern markets, in or near three or four western cities; Chicago, St. Louis, Springfield, and Burlington, are suggested as suited to the present demand, but Kansas City, Omaha, and Abilene would soon be added. In these towns let large slaughter-houses be erected with all the refinements and improvements known to science. For instance, the use of dry loam and of carbolic acid will so effectually absorb and utilize all the filth of slaughter-pens and slaughter-houses that such buildings need not pollute the waters of rivers and harbors in the least. As a part of such establishment, a large cooling-chamber is required, where as many as two thousand quarters could hang at a time. By absorbent surfaces or substances, these chambers should be kept dry as well as cool, and the animal heat as drawn should be driven off and fresh air supplied. From this cooling-room the meat should be loaded into refrigerator cars, and enough should be taken from one abattoir to make up a meat express train, which should move at 20 miles an hour, and make not more than three or four stoppages between the great rivers of the West and the eastern cities. In this way, within forty to fifty hours from the time a beef is killed, his quarters, in perfect condition, could be hanging in an eastern market-house. The many incidental advantages of such an improved system of meat supply need not be fully described here; the blood and offal would be retained and applied to corn and grain lands, for which they are the best fertilizers. The industries that are connected with a proper utilizing of the hides, hair, horns, bones, and gelatine, would enlarge manufacturing enterprise in those sections where production is out of proportion to local consumption. However important these advantages, they are trifling as compared with the relief of animal suffering, for which, as the business is now conducted, we have no arithmetic subtle enough and large enough. Medical men cannot tell us just what maladies are bred by the use of feverish and livid meats, or by the introduction into the system of the saltpeter that is largely used to make bruised meats less offensive to the eye; but no physician will say that the flesh of a feverish,

dull, and bruised animal, worried by long travel, and sore in every quarter from kicks and pounding, is wholesome food.

The whole subject of the meat supplies of this continent, the grazing interest, the drovers' trade, its relations to railroads, and the butchering and sale of meats have received very little of the attention of law-makers or of organizing talent in any form. In some respects these things can be left to the working of the great laws of traffic, but traffic is guided solely by immediate self interest; it is incapable of far-sighted wisdom; it is blind to the essential and permanent good of the greatest number. There are two steps which the Government can take without the least impropriety, and which, in concluding this paper, we venture to urge upon the attention of Congress.

1. The appointment of a commission to examine into the subject of the transportation of live animals, to ferret out its abuses, and suggest modes by which those abuses and the mischief they create may be mitigated or wholly removed.

2. The offering of a special prize of honor to the inventor who will perfect and carry into practice the best method for the transportation of dressed meats over long distances, and at all seasons.

Every branch of this general subject—that of feeding one section of the country from the surplus of another section—gathers importance with the lapse of every year and the building of every new east-and-west road. A few years ago the eggs of New York City were laid in the barns of New Jersey and Pennsylvania; to-day, Ohio is doing more than any other State to meet that demand, and eggs are forwarded by the barrel from Kentucky, Tennessee, and Indiana. The tubs of butter in Fulton or Market-street market may be made from the grasses of Orange, Herkimer, or Delaware County, but quite probably they came from Wisconsin or Kansas. The increase of railroads, the addition of through lines, and the increasing speed of all the trains, are year by year working important changes in market systems. The farmer was once but a day's drive by horse from the city where his surplus was consumed; now he is five hundred miles away; in another decade he will be a thousand miles away; yet in some respects he is nearer than he was when the spires of his market-town could be seen from the hill back of his house. Marketing thus grows into a special trade, requiring special confidences with railroad men and a knowledge of cities that the working farmer has neither the time nor the tact to acquire. On the other hand, the crowds in great towns who must buy at the nearest store, and must buy a cheap article no matter how it looks or smells, will constantly increase; this increase is inseparable from a high and many-sided civilization such as ours. From this situation the perpetual and growing demand is that the producer be, in every sense, brought nearer the consumer, and the consumer be brought into closer and more natural relations with the producer. A wise and sagacious government will give its closest attention to the solution of this problem.

The efforts of this Department, through which the attention of the Government was first called to the dangers of the splenic fever derived from southern cattle, and to the spread of the pleuro-pneumonia, as well as to the losses incurred by neglect and inhumane exposure of farm stock, will still be directed to the improvement of cattle transportation and the abundant supply of healthful meats at fair prices to the dwellers in American cities. It is a subject of national importance, and one demanding deliberate investigation, and such general legislation as may be required to give efficiency to practical reforms in cattle transportation and meat supply.

FARMING IN NEW ENGLAND.

Does farming pay in New England? This vexed question has provoked much discussion of late in the literature and social life of the country districts of the East. It is stated, on one side, that the farming population has decreased; hill farms have been given over to pasturage or natural forestry; hired labor is not generally found remunerative; the boys are leaving the farms, and the girls are following the boys to the West, to the commercial cities, and to the manufacturing centers. On the other hand, it is asserted that high prices are obtained for farm products; the soil yields more per acre than the general average of the country; some branches of production have actually shown an advance during the last decade; and even that the concentration of available labor on the more easily worked soils, with the abandonment of rough and rocky lands to forest growths, constitutes a policy sound and sensible, promotive of production directly, and of indirect advantage by its tendency to the modification of climate. These assertions, on both sides, are all either positively true, or else partially and from a certain standpoint correct. Labor upon ill-conditioned soil, on unsuitable crops, or with mismanagement, may not prove remunerative, while that directed in right channels, upon a soil having the elements of fertility in soluble and otherwise available condition, may yield a hundred-fold in profit.

It is true that agriculture and kindred arts do not occupy the highest place in the industry of New England, or secure the largest profits of labor in that region. An advanced position has long since been taken in manufactures, and a large portion of the local labor, skill, and business tact has been employed in the mechanic arts. Commerce is a prominent and profitable resource of the large cities; and the fisheries employ the labor and capital of a portion of the coast population. The comparatively small class employed in rural pursuits, depleted by emigration induced by the fertility and cheapness of Western lands, has been drained of its youth, skill, and enterprise to a degree seriously interfering with spirited and aggressive effort. Many a farm of ample acreage is left to the rheumatic labor of advancing decrepitude, in seedtime and in harvest, in the care of stock, marketing of products, and purchase of supplies. There is no strength for repairs, no ambition for improvement, and no expectation of more than a bare subsistence. Is it strange that discouragement should be felt and expressed in such a case? This discouragement is thus rather accidental than necessary. That there does not exist real cause for gloomy forebodings is due to the influence of other industries in creating markets and advancing prices of farm products.

EXAMPLES OF PROFITABLE FARMING.

This topic has been suggested by communications from farmers of New England, and by discussions at conventions and in the newspapers. We have made no general investigation into the status of New England farming, and shall not present here its salient points in detail, but will give a few of the communications received which present evidence of profitable farming, and suggest a possibility for the many which has already been achieved by a few. The first statement is from a well-known agriculturist in Connecticut, Mr. T. S. Gold, of Cornwall:

The following reports of successful farming in Connecticut are selected from different sections of the State, with the design of showing that skillful, intelligent culture pays a good return on the investment. I have avoided those cases where men have applied large means obtained either by inheritance or from other pursuits to the im-

provement of their farms. The price of land in Westport and Greenwich is affected by proximity to New York, and its value for residences and country places is often more than for strictly agricultural uses. An extract from the concluding part of the report of the Connecticut State Agricultural Society shows somewhat the relative rank of our farmers, especially in stock raising:

"A word in behalf of Connecticut agriculture. Is it worthy of State patronage? Can we do anything at farming in Connecticut? At the New England fair held last September, at Manchester, New Hampshire, Connecticut received the sweepstakes and herd premiums in the four leading breeds, Devons, Short-horns, Ayrshires, and Jerseys, with a large share of the first premiums in each of these classes. The competition was close, for there never was gathered a better show of cattle in New England. This is the rank we hold with our cattle. From the report of the Fairfield County Agricultural Society I find that Mr. T. B. Wakeman, of Westport, received a net profit of $2,500 from three acres of grapes. Colonel Thomas A. Mead, of Greenwich, had [illegible] bushels of shelled corn per acre, on a field of ten acres, one single acre yielding 126 bushels of shelled corn. Mr. Arthur Sherwood, of Westport, raised 300 bushels of potatoes on one acre, and Mr. Elisha Gray, of Westport, had on one acre 800 bushels of onions. This for a dry season. Last year Messrs. S. M. and D. Wells, of Wethersfield, raised 1,000 bushels of onions per acre, which sold on the field for $1 25 per bushel. Why need we be ashamed of Connecticut agriculture, when we have such examples for our encouragement?"

Westport is situated on the Sound, about 40 miles from New York, with which it has direct communication both by water and railroad. High culture with high manuring has resulted in vastly increased productiveness. Onions, potatoes, hay, and fruit form the principal articles of sale from the farms. About sixteen years since the farmers here began the application of leached ashes, which practice has so increased that now, in an area of six miles square, 70,000 bushels of ashes are annually used. These are brought in canal boats from Canada, and cost twenty cents per bushel. In addition to this the same territory uses about 80 tons of bone-dust and twenty tons of superphosphate. Many single acres are shown from which the gross product, either in onions or fruit, has exceeded $1,000 per acre, while the general product of farm crops of all kinds is very large. As examples I give the product of three farms. That of Mr. F. D. Wakeman, Westport, containing 60 acres, valued at $24,000, is devoted mostly to fruit. The products sold in 1870 were:

Grapes, 3 acres, (mostly Concords and Hartford Prolifics,) 30,000 lbs	$2,500
4½ acres potatoes, sold 400 bushels	500
Strawberries, raised in part between the grape vines, 2,500 quarts	500
Currants and currant bushes	500
Apples, pears, and other fruits, wine and cider, and grain	2,100
Hay, 20 tons, at $30	600
Pigs	800
	7,500

Mr. Wakeman keeps fifteen or more breeding sows, selling the pigs. The grain needed for them, besides the refuse of the farm, is mostly raised. This year he had five acres of wheat, yielding 30 bushels per acre; a part sold for seed at $2 25 per bushel. No account is taken of what is consumed in the family or used for necessary teams, and by the cows furnishing milk and butter.

There was an outlay of $100 for fruit-boxes, and $1,600 for labor	$1,700
About 1,000 bushels ashes per year	200
Interest on farm and tools, at six per cent	1,500
Taxes and other expenses	600
	4,000

Deducting this from the gross sales, we have $3,500 remaining. The value of the proprietor's own labor and supervision must be deducted from this, except so far as it is met by his own support and that of his family, mostly derived from the farm.

Mr. H. B. Wakeman, of Westport, gives "a fair estimate of income and expenses for the past year" of his farm of 60 acres, valued at $24,000. He received for strawberries $2,500; raspberries, $200; currants, $900; grapes, mostly Concord, $1,200; pears, $150; quinces, $100; early rose potatoes, $500; onions, $500; strawberry plants, $150; currant bushes and cuttings, $600; hay, $150; pigs, $50; total, $7,000. In addition to this he made 750 gallons of wine, 225 bushels of corn, 70 bushels wheat, 20 bushels rye. The corn, wheat, and rye are consumed. Quite a sum is realized from butter and eggs sold.

The expenses for help were $1,700, (mostly German and Swede, which is about one-third cheaper than Irish;) one ton superphosphate, $60; one ton bone-dust, $35;

average about 1,000 bushels ashes per year, at 20 cents per bushel, $200; interest and taxes, $2,000; total, $3,995. This leaves a profit of $3,005, without considering the products not estimated. The Messrs. Wakeman are brothers. Another brother conducts an adjoining farm with like energy and success. The old farm upon which they were raised, and which then yielded but scanty returns for rude culture, now pays well by its abundant crops for the plentiful and intelligent labor bestowed upon it.

Mr. Franklin Sherwood, and his son, Arthur Sherwood, of Westport, have a farm of 50 acres, worth $400 to $600 per acre for farming purposes. They obtained this year, on one acre and 34 rods 400 bushels of early rose potatoes, worth $1 25 per bushel; 90 barrels of white globe onions on 4½ acres, at $7 per barrel, and 600 barrels of red globe, at $5 per barrel, worth, together, $3,630. On the onion land 25 loads of barn-yard manure per acre were applied, and one ton per acre of bone-dust on 2½ acres. The total expenses for labor and manure did not exceed $630, leaving $3,000 for interest, supervision, and profit.

These were the two principal crops sold, but Mr. Sherwood had a fine crop of Surprise seed oats, potatoes of several varieties, fruit and cider, yielding enough to pay the hired labor, which cost about $1,000.

Captain Sherwood till within a few years followed the sea. His success as a farmer illustrates the benefit of thorough business habits upon the farm.

Mr. Nathan Hart, of West Cornwall, in the northwestern part of the State, makes the following statement:

"My farm consists of 130 acres, 30 acres being in wood and unimproved swamp land. The swamp land up to this time has been valuable only as a deposit of rich muck for mixing with more concentrated manure and as an absorbent in manure cellars. The farm crowns a hill, running east, south, and west to the valley, giving it a warm exposure. I came into possession of the place in the spring of 1848, when the buildings were out of repair; the surface of the meadow and arable land was thickly covered with rocks, from half a ton to eight or ten tons in weight, so that there was not an acre that could be mowed conveniently with a machine. The first year the farm carried 13 cows, a yoke of oxen, and one horse, with a purchase of a little extra feed for winter use.

"With a farm in this condition, bought, with the stock and implements, mostly on credit, how to pay for it, and at the same time improve it, was the problem to be solved. To show that it has been done to some extent, I will state that in the years 1869–'70, with $35 paid for pasturage, the farm carried 23 cows, one pair of oxen, and two horses, and $50 worth of hay and straw was sold. Forty acres have been cleared of rocks, laid in substantial walls, so that machinery is now used with facility, and the whole is in a good state of cultivation. The house has been repaired at an expense of $2,000, new barns have been built with manure cellars under the stabling, and a working capital concentrated many fold greater than existed at the beginning. Money loaned has been lost, which if safely invested would now have amounted to more than half the present capital. The pasturage has been increased by cutting off the wood and clearing land well adapted to grazing. The wood brought about $2,000 gross. Fields have been cleared of all the rocks not too large to blast or move without blasting and piled up in substantial walls, and the land has been thoroughly manured and planted with corn, followed by oats or wheat and seeded with clover and timothy. In this way forty acres have been fitted for the plow or mower, and the raising of any crop adapted to this climate. For example, a two-acre field, cleared as stated, was manured with 21 cart-loads of barn-cellar manure per acre and planted with corn, and gave a yield of 75 bushels per acre.

"The following year the field was manured as before and planted with tobacco, with the exception of one-half acre unmanured and planted with potatoes. The tobacco yielded 3,333 pounds, and sold for $691. In the fall, after the crops were removed, the field was sown with wheat and seeded with clover and timothy. The yield was 36 bushels of handsome white wheat per acre. The following years it was mowed twice, yielding a very large crop. With top-dressing once in three years it has continued this yield to the last year, when the second crop failed from the drought.

"Another field of seven acres was taken up in the same way, one half at a time. The yield of corn was 75 bushels per acre, and of oats 72 bushels. Another acre in the same field at one time gave 102 bushels of shelled corn, and the subsequent grass crops were in proportion. These crops were not guessed at, but the land was measured with chain and compass, and the grain accurately measured, and a premium obtained from the county and State agricultural societies.

"This success is mainly due to a thorough system of clearing the land and manuring, doing well what is done, and making it pay as the work goes along. Let no man suppose, however, that he can take a farm in all its native roughness and sterility, and with little capital but his bare hands, and arrive at desirable results, while eating the bread of idleness, allowing his manure heaps to be drenched with rains, and going on from year to year without any definite plan of operations."

Mr. Hart's farm is situated away from any village or very favorable market. He keeps a dairy, and until the last two years made butter and cheese. Since then he has

sent milk to New York. His sales have been mostly dairy products, and fruit, and an occasional crop of tobacco.

Farming in Middlefield.—Middlefield is situated near the central part of the State, and is well located for farming. Mr. P. M. Augur sends the following statement relative to fair representative farms, and adds: "I believe that in Middlefield there is not one farm that with fair management, after allowing full charge for labor and fertilizers, will not pay a fair percentage on the investment. There are probably few places where machinery, out doors and in, has been more generally introduced or with better results A better class of stock is kept than formerly, and more attention is paid to making permanent improvements. Concerning agriculture in Middlefield the future looks hopeful."

No. 1.—Value of farm, $6,000; implements, $500; stock, $1,000; total, $7,500. Produce sold: Wool, $25; garden vegetables, $40; poultry produce, $100; potatoes and turnips, $200; butter, $150; forest products, $150; orchard, $120; slaughtered animals, $150; growth and sale of animals, $300; total, $1,235. Labor, $450. Net returns, $785.

No. 2.—Value of farm, $12,000; implements, $500; live stock, $2,300; total, $14,800. Produce sold: Tobacco, $1,200; wool, $21; potatoes, $75; orchard, $105; garden products, $252; butter, $300; forest products, $75; slaughtered animals, $700; sale and growth of animals, $400; total, $3,131. Labor, $1,500; fertilizers bought, $300; total expenses, $1,800. Net returns, $1,331.

No. 3.—Value of farm, $10,000; implements, $300; stock, $2,200; total, $12,500. Products sold: Tobacco, $800; potatoes, $38; orchard, $60; butter, $375; cheese, $24; forest products, $180; slaughtered animals, $735; sale and growth of animals, $375; total receipts, $2,587. Labor, $1,200; fertilizers bought, $150; total expenses, $1,350. Net returns, $1,237.

No. 4.—Value of farm, $7,000; implements, $300; live stock, $1,095; total, $8,395. Produce sold: Potatoes, $200; wool, $45; orchard products, $100; butter, $200; forest products, $185; slaughtered animals, $634; sale and growth of animals, $300; total receipts, $1,664. Labor, $550; fertilizers, $50; total expenditures, $600. Net returns, $1,064.

Colonel Thomas A. Wood, of Greenwich, a successful farmer of more than threescore and ten years, writes me of his farming experience, and especially of his success with plaster, by the moderate application of which the product of the pastures made a three-fold increase: "My farm of 260 acres is assessed at $32,000; buildings, $4,000; farming implements, $950. Wheat before the aphis appeared averaged 25 bushels per acre; corn averages 75 bushels per acre; potatoes, 175 bushels; oats, a little over 50 bushels; hay, 2½ tons per acre. Sales consist of fat cattle, lambs, pork, hay, apples, corn, and a little wheat and oats and a few potatoes. The average yearly aggregate of sales from 1860 to 1870 has been $6,700. No account is taken of what is used in the family. Milk, butter, and other small sales meet the grocer's bills. The expenditures for cattle and labor amount to $3,160; mechanics' bills, $435; taxes, $827—making a total of $4,460, and showing a balance of $2,240.

"My rotation is corn, oats, wheat, and then grass eight years. I have about 45 grown cattle and horses in the stables. Every morning the droppings are removed and piled up or drawn to the field designed for corn. The litter, when saturated with urine, is replaced with fresh straw, and is as good for manure as the solid droppings. For the corn crop I apply about 25 loads of manure, of 30 bushels each, per acre. This is spread as soon as the frost is out of the ground, usually from the 20th of March to the 1st of April, so that the rains shall wash the soluble parts into the soil and cause the grass to grow. By the early part of May, when I begin to plow, the grass is four to six inches in height. Grass, and the young roots of grass, feed the worms until the corn gets beyond their reach; and the sod rots quickly, and forces the corn forward rapidly. This was the culture the past season: I plowed with furrow 10 inches wide and 5 deep; harrowed three times with an iron-toothed harrow, and used marker of my own construction 3 feet 7 inches each way, placing the corn on the surface, 3 grains in a hill; ploughed four times, hoeing 3¼ days on each acre: put but little dirt to the corn. Planted the 12th and 15th of May, and cut up the last week in September.

"In plowing the corn I only plow deep enough to cut up the grass and weeds, say two inches, twice from and twice toward the corn. I use two horses, one horse taking the furrow, making a steady and fast team—not more than half the labor for the plowman, and doing one-third more work in a day, and worth nearly two plowings with one horse. From the commencement of plowing to finishing cutting the stalks, it takes 15 to 20 days' work to the acre, at $1 25 per day, say $22, or including team $30 per acre.

"If we add to this the labor of applying the manure at $10 per acre, and interest on the land at $250 per acre, $15 more, we have $55 as the total cost per acre. Counting the corn at $1 per bushel, this leaves $27 50 net profit per acre, or $313 on the whole field. The stalks pay for the husking, and the produce fed on the farm supplies manure for another crop.

"Five years ago I planted two parts Sciota and one part a small dwarf corn that had been on the farm from my earliest recollection. There were 11 acres in the field, one-half very dry and porous, the remainder a little moist. Five acres of the latter yielded over 100 bushels per acre as estimated by good judges. In a wet season the other part of the field would have been the best. Thirty hills were put into a stack, and seven contiguous stacks selected as an average, and husked by themselves, weighed in the ear 429 pounds, shelled corn 371 pounds, cobs 58 pounds. This was the pure Sciota. Of the mixed Sciota, two stacks in the ear yielded 152 pounds, cobs 18 pounds, shelled corn 134 pounds, or 2¼ bushels. These two stacks were a fair average of the two acres, making 106 bushels per acre. Four acres were planted with the common eight-rowed white and yellow corn, which yielded about 70 bushels to the acre."

Mr. George E. Waring writes of a farm in his neighborhood, in the vicinity of Newport, Rhode Island, of 26 acres, upon which 25 cows have been kept. The pasture contains twelve acres, and twenty cows are kept upon it during the summer. The feed purchased is only equivalent to the keeping of his teams. The butter, milk, cream, and calves sold in 1870 brought $1,862 15, nearly $75 for each cow, besides the skim-milk that was turned into pork. The sales of 1870 were as follows:

Eggs	$144 20	Turnips	$100 00
Turkeys	96 00	Round turnips	43 00
Chickens	66 25	Calves	635 00
Butter	196 00	Pork	234 00
Cream	235 20	Lambs	144 00
Milk	795 95	Wool	48 60
Potatoes	687 25	Squashes	12 00
Tomatoes	50 00		
Onions	78 00	Total	3,758 45
Carrots	43 00		
Beets, (mangold)	150 00		

This farm is worked at a profit, but the significant fact concerning it is that the average value of product per acre was $144 55. A farm of 200 acres, producing at this rate, would yield a gross income of $28,910. Mr. Waring says that these results are not due to what are known as "modern improvements;" that "there is nothing done here that is not done on any good farm in New England; but everything is done with a will; and industry, perseverance, and thoroughness characterize every part of the work. The cultivation is thorough and cleanly; the use of manure excessive; the feeding high; the marketing skillful; and the economy in every department complete."

A few examples of profitable farming in Vermont are at hand, by no means the most striking, but such as can be obtained from any neighborhood, however isolated or small. Mr. Charles A. Sylvester, of Barnet, bought a farm for $4,000, having a capital of only $2,000. It was in a low state of cultivation, and had no buildings or fences of material value. He kept sheep and horses, and nearly doubled the yield of wool of the former, and improved by selection the value of the latter. In sixteen years he trebled the production of the farm, erected substantial buildings, and then sold the farm for $11,000, and had left nearly as much produce and other personal property on it as it cost in the beginning.

Mr. John Quinlan, of Charlotte, now owns one thousand acres of Champlain Valley soil, as the result of energy and industry upon the farm, although he commenced life as an agricultural laborer, has met with losses and discouragements, and has raised and educated a large family.

A farm was purchased in Albany by Frank Vance, for $800, which was sold fourteen years afterward for $8,000. Mr. James Vance has 100 acres that cost, nineteen years ago, $1 to $2 per acre, now worth $8,000, though it is three miles away from a village. Horses and sheep have proved profitable upon this farm. An income of eight dollars per

annum for each of the breeding ewes is regularly obtained, the lambs bringing from $4 to $5 each before the fourth of July.

In Williamstown, in the White River Valley, Mr. Edson Martin has a farm of 120 acres, upon which he cuts about 100 tons of good hay annually, at the rate of two to three tons per acre, and finds profit in agriculture, as do all others who manage prudently to increase fertility and production.

Mr. G. B. Brewster, of Irasburg, bought a farm of 220 acres, nineteen years ago, costing $3,500. It was in poor condition; corn was a failure upon it; grass was light, and wheat would not grow. By successive manuring and good cultivation fertility increased, 25 bushels per acre of wheat were obtained, 70 of oats, 300 of potatoes, 70 of corn, and 900 of turnips. By legitimate farming a property of $15,000 was thus obtained from a beginning of a few hundred dollars, upon an intractable and unpromising soil.

Mr. J. W. Pettee, of Salisbury, finds no difficulty in obtaining 80 to 90 bushels of ears of corn per acre, on land which formerly yielded three-fourths of a ton of hay mixed with daisy and johns-wort. A moderate quantity of manure, combined with first-class culture, produced this change.

Mr. Levi Bartlett, of Warner, New Hampshire, a veteran observer of general agriculture, and a practical and successful farmer, in a region of not more than average fertility, (or sterility, as the reader may prefer,) communicates to the Department the following statement:

A large majority of farmers here succeed in their business so far as to obtain a good living and pecuniary independence, and some accumulate very respectable fortunes. These facts are demonstrated by the numerous well finished and furnished houses, barns, and out-buildings for storing grain, carriages, farming implements, &c., to be seen in almost every town; and these facts bespeak a thrift and enterprise not even dreamed of by the most sanguine half a century ago.

On the other hand, in many of the long-settled towns in the hilly, rocky portions of the State, the population has gradually decreased during the past twenty years, as the late census returns plainly show; and in most of these towns there are numbers of once good farms that have been abandoned, the buildings have been removed, and the once productive fields turned out to pasturage, and will ultimately be covered with a forest growth, the seedlings of which spring up in these worn-out soils; still, there are in all these towns good farms, and farmers who annually find "there is money in their business," even in the business of legitimate farming alone.

The spirit of emigration is an inherent principle in the "genus homo;" discontent among the farmers of the fertile soils of Illinois is as prevalent as it is among the same class residing on the granite hills of New Hampshire. To report fully "examples of profitable farming in New England" would require volumes; but for the information of the cultivators of the soil in different sections of our widely extended country, I will give a few "illustrative examples" in this section of New England.

During the past few weeks I have made excursions in several counties of this State, and noted down some facts connected with the farm practices in different sections, and on individual farms. We have no great staple crop like the wheat and corn of the West, or the cotton, sugar, and rice of the South.

Our soil, climate, and social condition compel us to pursue a mixed husbandry, to grow a variety of farm products, and these are varied according to the locality in which the farmer resides, and the requirements of the markets, and whether these are near or distant from his farm.

Some weeks since I made a visit to the town of Littleton, 112 miles north of Concord, N. H., well up in the White Mountain region. While there I spent two days in four of those "northern towns," and visited a large number of farmers, and found them in the occupancy of good farms, farm buildings, and everything betokening thrift and enterprise. I think the drought was not so severe there the past season as in the more southern portions of the State, as the crops generally were good; corn, on many of the farms, yielding 50 to 60 bushels, shelled, per acre. The hay and grain crops were in similar proportions. This section of the State is noted for its large yields of potatoes. Immense quantities are annually worked up for the starch they contain. On one farm visited, there were over five hundred bushels grown on two acres. These, at the starch-mills, command thirty-five cents per bushel, thus giving a return of $175 for the product of the two acres. I was told that much larger yields were harvested on some

farms. The variety generally grown for starch is known as the "California potato." It is not a good table-potato, but is preferred by the starch manufacturers. This is a good hay and grass-producing section, and large quantities of timothy-grass seed are raised, and the high price at which it has been sold for the past few years makes it a profitable farm product. Much more might be said of the prosperous condition of that section of our State; of its fine horses, herds, and flocks; of its railroad facilities for transporting to market its wood, lumber, bark, charcoal, and numerous other products, all of which largely contribute to the increasing wealth of that part of the "Old Granite State."

More recently I visited Hanover, the town in which the New Hampshire Agricultural College is located, and spent a day in driving around among the farmers of that ancient town, the settlement of which commenced over one hundred years ago. There are large numbers of fine and productive farms. Much of the land consists of a finely comminuted and somewhat clayey soil, free from rocks, and easily cultivated. All of the farm crops cultivated in that section make good returns, especially wheat, both spring and autumn sown. From five or six of these farmers I obtained statements of the average yield per acre for a series of years. There were better crops in some seasons than in others. The lowest yield in any one season was twenty bushels. The largest, ninety-eight and one-half bushels on two acres of land. This was in 1860, a favorable season for the wheat crop in this section. Some of the records are of the crops for eleven years in succession on the same farms.

Mr. C. C. Foster the past season raised twenty-five bushels of winter wheat on one acre. The seed was obtained from the Department of Agriculture. Mr. F. has forgotten the name. It very closely resembles the "White Touzelle winter wheat," imported from Marseilles, France, by the Department. The land planted with corn is heavily manured and followed by wheat and grass-seeds. As far as I can learn, there are but few, if any, sections of the country where larger average yields of wheat are grown than in the town of Hanover. A portion of the farmers in the town of Fairmount, Onondaga County, New York, obtain about the same average.

I will now give the farm practices of three of the prominent farmers of Merrimack County, who have made farming profitable, but who differ somewhat in their practice and in the disposal of their products.

In 1856 Colonel David M. Clough, of Canterbury, purchased the farm he now occupies for the sum of $4,400. It contained about four hundred acres, two hundred of which were interval, lying on the eastern bank of the Merrimack River, opposite the village of Boscawen Plain. The remainder was pasture and woodland. A few years previous to his purchase most of the wood and timber had been removed. For more than thirty years a widow had held a life estate in the farm, and during this period it had been rented and largely cropped with corn and oats, which, with a portion of the hay, were annually sold, and no manure purchased. By this skinning process the farm had become badly worn; the buildings and fences were in a most dilapidated condition, and a large portion of this once fertile interval had been turned out as pasture. To renovate the tillable fields, large quantities of muck and lime were composted. Muck and a clay marl, of which there are inexhaustible quantities on the farm, were used in the barn-yards, cattle and sheep hovels, and hog-yards. Fences were rebuilt with good boards and chestnut posts. The large, old farm-house was completely remodeled and renovated, both inside and outside, and additions made to it, and old barns were removed and splendid new ones erected.

When Colonel C. came into possession of the farm there were about twelve tons of English and about the same quantity of natural or low-ground hay cut upon the farm, sufficient, with some grain feed, to winter twelve head of cattle, thirty sheep, and two horses. He now winters upon an average ninety head of cattle, six horses, old and young, and one hundred and fifty sheep. He had at the time I was there sixteen hogs, about eighteen months old, and a large number of last spring's shoats. The old hog will average not far from four hundred pounds each. For several years past the average sales have been about $1,500 for beef cattle; $500 for pork; sheep, lambs, and wool, $400. A few years since he sold for slaughter 200 sheep at seven dollars a head, aggregating $1,400.

The proceeds of the farm this year are 150 tons of hay, 800 bushels of corn, 800 bushels of oats, and 50 bushels of wheat. The whole of the hay, most of the corn, and a large portion of the oats are fed to his farm stock and to horses from the cities to be wintered. Having lost several acres of his interval land by the washing away of the soil, which is twenty feet deep at that place, he has, by the expenditure of over six hundred dollars, prevented future inroads by sloping the banks and cobbling them with stone, drawn two miles. He has, during the fourteen years of his occupancy of the farm, expended over four thousand dollars in repairing the old and erecting new farm buildings. The results of his farming, in a pecuniary point of view, are satisfactory, he having now a larger surplus of cash on hand than the farm originally cost him. Colonel Clough plows his land deep, manures high, and cultivates thoroughly, sows liberally of grass seeds, and harvests corresponding crops.

About thirty years ago Mr. W. H. Gage purchased the Colonel Chandler farm, situated in the southern part of Boscawen. The farm contained about 400 acres, 100 acres of which were tillable interval, and about 40 of low interval, which yielded fair crops of hay of various qualities, from good to very poor. The remainder of the land was forest and pasture. He gave $6,000 for the farm, one-third cash, about all the available funds he possessed. The farm had been rented for a number of years, and was badly run down. The course of farming he has pursued for a number of years has been to feed the hay and grain raised upon the farm to his cattle, sheep, and swine. The rearing of fine stock has been a specialty with him, especially oxen. For the past twenty-five years he has received more premiums for oxen, at our State and county fairs, than any other farmer in the county. In March, 1869, he sold two yoke of oxen for $800. In March, 1870, two yoke for $750. It has been a maxim with him to increase the fertility of his farm, and consequently his crops. This he has accomplished by selling most of the products of his farm in the form of beef, pork, mutton and wool, butter and cheese.

For many years past he has kept 4 to 6 hogs. When 18 to 20 months old they have averaged, when dressed for market, about 500 pounds each. The clear pork is salted and sold during the succeeding summer at the large manufacturing village of Fishersville, at an average of 22 cents per pound. Lard and hams from 20 to 22 cents. There are kept about 30 head of cattle, 75 to 100 sheep, and 2 horses. Corn annually grown from 6 to 8 acres; yield per acre 55 bushels. Oats follow the corn; yield 60 bushels per acre, about one-half of which are sold at an average of 70 cents per bushel.

The farm is now valued at $40,000, and other assets would bring his property well up to $50,000—the accumulations of a little over thirty years.

The third and last farm I shall refer to is that now owned by Joseph B. Walker, Concord. This farm has been under cultivation about one hundred and forty years. Its original owner was the late Rev. Timothy Walker, the first settler and only minister of that town for fifty-two years. The farm came into the possession of his son, the late Judge Timothy Walker. Upon his death it became the property of his son, the late Captain Joseph Walker, whose son, Joseph B. Walker, the present owner of the farm, inherited it when only ten years old, he being the only surviving member of the family. His guardian rented out the farm, which was thus managed for twenty years. In the mean time Joseph B. graduated at Yale College, studied law, and opened an office in Concord. He undertook to carry on the farm and his law business at the same time. After two years' trial of farming and law, he found one or the other must be given up. He had the good sense to quit law and become a farmer.

During the twenty years the farm had been leased, the buildings and fences were sadly out of repair, large portions of the fields were overrun with bushes, and there was a large decrease of hay and other crops during the period.

The farm consisted of about 350 acres, 100 of which were Merrimack River interval, a large portion of which could be plowed, and with manuring would yield fair crops of corn and grain. About 30 acres were either covered by the waters of Horseshoe Pond, or were too wet for the production of hay. To drain the pond as far as practicable, he, fourteen years ago, cut a large and deep ditch from the east end of the pond across the interval, nearly half a mile, to the river. The interval is bounded on the north by the Merrimack River. The surface of the land on the river bank is about 14 feet above the usual summer low-water mark. From the river the land gradually slopes southward to Horseshoe Pond. Forty-five rods south of the river Mr. Walker commenced excavating the soil, for the purpose of putting in a plank drain from that point to the river. The south end of the ditch was 8 feet deep, but, as the ground rose gradually, before the bank of the Merrimack was reached it was 14 feet deep. Sound white-pine plank were used for making a box or pipe—inside 8 by 12 inches, 96 square inches—for the passage of the water from the open ditch to the river. This box drain has done so well during the fourteen years it has been in operation that 45 rods more of similar drain have been put down during the past autumn, permitting the filling up of that length of open drain. From the covered drain to the pond the bottom of the open drain is boarded, the ditch being about 3 feet wide at the bottom. Before the floor was put in, rushes and aquatic grasses obstructed the flow of water, and were gradually filling the ditch.

I have thought it might be of *practical use* to be thus particular in describing Mr. Walker's process of lowering the water of Horseshoe Pond several feet, thereby reclaiming about thirty acres of once almost worthless land, and bringing it up to an average value of $150 per acre. This desirable object has been effected at an expense of about $500. During the eighteen years he has carried on the farm, the crops of hay and grain have been more than doubled.

His annual clip of hay is about 120 tons, of which 70 to 80 tons are sold, varying in price, in different years, from $18 to $30 per ton.

As hay is his leading crop, grass immediately follows corn, without an intervening grain crop. Every autumn he plows about twelve acres of grass land, six acres of which are heavily manured and planted with corn; the following spring the other six

acres are sown with oats. Average yield of each, fifty to sixty bushels; after the corn is harvested the land is plowed and sown with grass-seeds. The oat-ground is manured, plowed and sown with grass-seeds. Several acres are also planted with potatoes, beans, root crops, &c.

There are kept upon the farm four large oxen, six cows, two horses, and twenty or more cattle of various ages; most of the corn and oats are fed to the farm stock. Materials are carted into the barn-yard and cellars for composting with green manure. Mr. Walker also uses the hair, lime, fleshings, &c., from a large tannery near his farm. These materials are composted with large quantities of muck, and make valuable manure for his corn crops. He also purchases $200 worth of stable and some commercial manures. By these means, he is annually increasing the fertility of his lands, notwithstanding the large quantities of hay sold.

He keeps six cows, the milk of which is sold at the house, put up in cans. The average sales of milk amount to $75 per month. The twelve acres of land seeded down in the fall yield a fair crop in August, similar in quality to second-crop hay. This is found to be a prime feed for the cows during the winter, producing a large flow of milk.

Mr. Walker keeps an exact account of the expenses of the farm and of its income, which at the end of every month is carried from the day-book to the ledger, and in this way he is able, at the close of each year, to ascertain the profit and loss of his farming operations. The profits over the entire cost of carrying on the farm are quite satisfactory.

It may be said that the farms I have described are made up of the alluvial soils bordering the Merrimack River, free from rocks, and easily worked when contrasted with the soils of the hill-farms; but thousands upon thousands of the farmers upon our hill-farms annually find there is "money in their business."

Had a judicious course of cultivation been pursued on a large portion of the now abandoned farm, they would have been to-day paying investments.

The selling of hay and grain from the farms, close feeding of the mowing fields every autumn, and reckless waste of the manurial resources of the farms, together with the natural restlessness and love of change that seem to belong especially to Americans, are, I believe, the principal causes of the decrease in the rural population in so many of the farming districts of New England.

Mr. S. Kilbreth, of Manchester, Maine, who was awarded the first premium for wheat by the Kennebec Agricultural Society, makes the following statement concerning it, which shows that wheat can be produced at a profit under good culture:

The land on which my wheat grew was a deep, gravelly loam, planted the previous year, part to corn and part to potatoes. Upon the part planted to potatoes, after harvesting, I spread six cart-loads of barn manure. Upon the part planted to corn, I put one shovelful of compost manure in each hill of corn; plowed and pulverized the ground in the fall; plowed again in the spring, and harrowed before sowing. Sowed the 5th of May two bushels of Java wheat, harrowed once, and spread upon the piece one hundred bushels of leached ashes; then harrowed again and rolled it. Harvested about the 10th of August; threshed the first week in September 22½ bushels of wheat.

DR.

3 cords of manure	$12 00
100 bushels of leached ashes	15 00
Plowing land	4 00
2 bushels wheat	4 00
Sowing	2 00
Harvesting	4 00
Threshing	4 00
Applying ashes, &c	5 00
Total	50 00

CR.

22½ bushels wheat, at $2 50 per bushel	$56 25
1 ton of straw	8 00
Manure and ashes left on hand	10 00
Total	74 25
Credit	74 25
Debit	50 00
Profit	24 25

STATISTICS OF PRODUCTION.

The statistics of agricultural production in New England, for the last three decades, illustrate the changes wrought by the causes enumerated above, showing decrease at one point and increase at another, and in the total an absolute depreciation, which is perhaps not quite equal to the loss of agricultural population, the use of labor-saving machinery more than compensating for decrease of fertility upon the neglected farms of the interior. The following table includes the aggregates of the census returns of live stock and principal farm products for the six New England States:

	1850.	1860.	1870.
Horses ....number..	212, 274	258, 992	259, 358
Mules and asses ....do....	376	357	961
Oxen and other cattle ....do....	860, 809	892, 846	715, 544
Milch cows ....do....	608, 219	679, 930	642, 593
Sheep ....do....	2, 257, 583	1, 779, 767	1, 449, 695
Hogs ....do....	361, 481	326, 176	241, 000
Corn ....bushels..	10, 175, 856	9, 164, 505	7, 347, 666
Wheat ....do....	1, 090, 894	1, 083, 193	1, 000, 693
Rye ....do....	1, 570, 589	1, 425, 851	703, 379
Oats ....do....	8, 101, 268	10, 895, 185	9, 169, 501
Barley ....do....	414, 496	1, 199, 119	1, 075, 059
Buckwheat ....do....	716, 044	990, 812	1, 189, 413
Potatoes ....do....	19, 618, 111	21, 343, 616	23, 928, 604
Tobacco ....pounds..	1, 405, 920	9, 266, 445	15, 870, 484
Hay ....tons..	3, 463, 652	3, 869, 200	3, 936, 560

It thus appears that milch cows have decreased 5 per cent. in ten years, other cattle 20 per cent., sheep 18, and swine 26, and that horses and mules have slightly increased. Corn shows a reduction of 19 per cent., wheat nearly 8, rye 50, oats 16, barley 10; while buckwheat is increased 20 per cent., potatoes 12, hay nearly 2, and tobacco 70. That hay should not fall off with the cattle may be partially accounted for by the increase of horses, which is probably much greater than is shown by the above figures, which only give the horses of the farm, while those of the cities, numbers of still larger magnitude in some of the States, are not enumerated.

In orchard and garden products the increase has been very large, being from $2,703,032 in 1850, and $4,959,455 in 1860, to $7,143,907 in 1870. Maine, New Hampshire, and Vermont have greatly enlarged the productions of orchards, and Massachusetts, Rhode Island, and Connecticut, that of gardens. The following table will show the rate of increase in the several States:

States.	1850.		1860.		1870.	
	Orchard products.	Produce-market gardens.	Orchard products.	Produce market gardens.	Orchard products.	Produce market gardens.
Maine	$342, 865	$122, 387	$501, 767	$194, 006	$874, 569	$266, 397
New Hampshire	248, 563	56, 810	557, 934	76, 256	743, 552	119, 997
Vermont	315, 255	18, 853	211, 693	24, 802	682, 241	42, 225
Massachusets	463, 995	600, 020	925, 519	1, 397, 623	939, 854	1, 980, 231
Rhode Island	63, 994	98, 298	83, 691	140, 291	43, 036	316, 133
Connecticut	175, 118	196, 874	508, 848	337, 025	535, 954	599, 718
Total	1, 609, 790	1, 093, 242	2, 789, 452	2, 170, 003	3, 819, 206	3, 324, 701

That the reader may examine in detail the changes in the several States, exhibited by the census of 1870, in comparison with that of 1860 and 1850, the following table is presented:

Changes in the several States exhibited by the census of 1870 in comparison with 1860 and 1850.

	Maine.			New Hampshire.			Vermont.		
	1850.	1860.	1870.	1850.	1860.	1870.	1850.	1860.	1870.
Horses ....number..	41, 721	60, 637	71, 504	34, 233	41, 101	39, 095	61, 057	69, 071	65, 015
Mules..........do....	55	104	336	19	10	37	218	43	252
Oxen and other cattle..........do....	209, 783	229, 619	203, 802	173. 633	169, 587	132, 218	202, 720	195, 783	140, 550
Milch cows..........do....	133. 556	147, 314	139, 259	94, 277	94, 880	90, 583	146, 128	174, 667	180, 285
Sheep..........do....	451, 577	452, 472	434, 666	384, 756	310, 534	248, 760	1, 014, 122	752, 201	580, 347
Hogs..........do....	54, 598	54, 783	45, 760	63, 487	51, 935	33, 127	66, 296	52, 912	46, 345
Corn..........bushels..	1, 750, 056	1, 546, 071	1, 089, 888	1, 573, 670	1, 414, 628	1, 277, 768	2, 032, 396	1, 525, 411	1, 699, 882
Wheat..........do....	296, 259	233, 876	278, 793	185, 658	238, 965	193. 621	535, 955	437, 037	454, 703
Rye..........do....	102, 916	123, 287	34, 115	183, 117	128, 247	47, 420	176, 233	139, 271	73, 346
Oats..........do....	2, 181, 037	2, 988. 939	2, 351, 354	973, 381	1, 329, 233	1, 146, 451	2, 307, 734	3, 630, 267	3, 602, 430
Barley..........do....	151, 731	802, 108	658, 816	70, 256	121, 103	105, 822	42, 150	79, 211	117, 333
Buckwheat..........do....	104, 523	259, 519	466, 635	65, 265	89, 996	100, 034	209, 819	225, 415	415, 096
Potatoes..........do....	3, 436, 040	6, 374, 617	7, 771, 009	4, 304, 919	4, 137, 543	4, 515, 419	4, 951, 014	5, 253, 498	5, 157, 428
Tobacco..........pounds..	....	1, 583	....	50	18, 581	155, 334	....	12, 245	72, 671
Hay..........tons...	755, 889	975, 803	1, 053, 415	598, 854	642, 741	612, 648	866, 153	940, 178	1, 020, 669

	Massachusetts.			Rhode Island.			Connecticut.		
	1850.	1860.	1870.	1850.	1860.	1870.	1850.	1860.	1870.
Horses..........number..	42, 216	47, 786	41, 039	6, 168	7, 121	7, 770	26, 879	33, 276	34, 935
Mules..........do....	34	108	103	1	10	43	49	82	190
Oxen and other cattle..........do....	129, 895	135, 422	104, 281	17, 564	19, 405	15, 569	127, 214	143, 030	119, 124
Milch cows..........do....	130, 099	144, 492	114, 771	18, 698	19, 700	18, 806	85, 461	98, 877	98, 889
Sheep..........do....	188, 651	114, 829	78, 560	44, 296	32, 624	23, 938	174, 181	117, 107	83, 424
Hogs..........do....	81, 119	73, 948	49, 178	19, 509	17, 478	14, 607	76, 472	75, 120	51, 983
Corn..........bushels..	2, 345, 490	2, 157, 063	1, 397, 807	539, 201	461, 497	311, 957	1, 935, 043	2, 059, 835	1, 570, 364
Wheat..........do....	31, 211	119, 783	34, 648	49	1, 131	784	41, 762	52, 401	38, 144
Rye..........do....	481, 021	388, 085	239, 227	26, 409	28, 259	20, 214	600, 893	618, 702	299, 057
Oats..........do....	1, 165, 146	1, 180. 075	797, 664	215, 232	214, 453	157, 010	1, 258, 738	1, 522, 218	1, 114, 595
Barley..........do....	112. 385	134, 891	133, 071	18, 875	40, 993	33, 559	19, 099	20, 813	26, 458
Buckwheat..........do....	105, 895	123, 202	58, 049	1, 245	3, 573	1, 444	229, 297	309, 107	148, 155
Potatoes..........do....	3. 585, 384	3, 201, 901	3, 025, 446	651, 029	542, 909	669, 408	2, 689, 725	1, 833, 148	2, 789, 894
Tobacco..........pounds..	138, 246	3, 233, 198	7, 312, 885	....	705	796	1, 267, 624	6, 000, 133	8, 328, 798
Hay..........tons..	651, 807	685, 331	597, 455	74, 818	82, 722	89, 045	516, 131	562, 425	563, 328

These tables exhibit the prevailing characteristics and tendencies of rural husbandry in this section, and show that the stock interest is declining, that breadstuffs command quite as little attention as heretofore, and that fruit-growing and market-gardening are rapidly increasing. It is not probable that the census returns include all the advance in these industries. It must be extremely difficult, if not impossible, to obtain a very near approach to completeness in returns of products grown everywhere, in town and country, in isolated patches; and the aggregate would be greatly enlarged if the immense quantities of wild berries could be included.

The decrease of milch cows has been 4½ per cent. in Rhode Island, 4½ in New Hampshire, 5½ in Maine, and 20 in Massachusetts; but Connecticut has made a slight advance, and Vermont an increase of 3 per cent. In all the States the number of "oxen and other cattle" has decreased. The decline in the numbers of sheep and swine has been heavy, yet in 1867 the number of sheep was undoubtedly greater than in 1860. The number of farm horses has increased in Maine, Rhode Island, and Connecticut, and decreased in New Hampshire, Vermont, and Massachusetts. If an enumeration of horses in the cities could be made, a different result might be attained in the latter States.

PRACTICAL SUGGESTIONS.

While the facts here presented are fragmentary, and the investigation incomplete, enough is learned to prove that rural pursuits are profitable in the hands of enterprising men, and to show that many farms are managed in an unprogressive manner and with unremunerative results. Gardening and fruit-growing, when followed with skill and method, yield handsome returns; and yet the demand, especially for early fruits and vegetables, is scantily supplied, and prices are high. The prices of small fruits are far higher in Boston and Lowell, and the quantity consumed much less in proportion to population, than in Baltimore and Washington. Norfolk sends immense quantities of *early* strawberries to those cities, but we never hear that New Hampshire or Maine sends *late* supplies after the local crop is gone. To be sure, there is greater eagerness for the first berries, yet the latest command high prices and meet a ready sale, and there is no surfeit of raspberries, blueberries, or blackberries to destroy the demand. There is a marked deficiency in production of the finer vegetables, as asparagus, spinach, cauliflower, &c., in interior towns, and tomatoes and other vegetables might be brought into market earlier by the ingenious and inexpensive forcing processes known to skilled market-gardeners, in profitable competition with the wilted, sometimes decaying and unwholesome vegetables brought from a great distance. It is astonishing that the farmers and mechanics of interior towns do not cultivate strawberries and other small fruits in their gardens to an extent fourfold greater than they already do. While there are fruit-growers and market-gardeners about Boston who are excelled in skill by none in the country, there are multitudes of interior towns which can neither boast advanced practices in horticulture nor early and abundant supplies from local sources.

Considerable advances have been made in the use of agricultural machinery; mowers are used on ten farms for every one cutting grass by horse-power ten years ago; but there are many farms smooth enough for the mower which still employ only the traditional scythe. Much of the labor of hand-hoeing, now exceedingly expensive, might be done with the horse-hoe; where rocks or other obstructions interfere, a small expenditure would fit the surface for machine cultivation.

The economy of farm machinery is illustrated by the reports of the use of the horse-planter and horse-hoe in Northfield, Massachusetts. Mr. J. Lyman claims to have planted (in nineteen hours) and hoed (in eighty-one hours) fifteen acres of corn, worth $1,014, at the cost of $33, or little more than 3 per cent. of the value of the crop. Mr. James Merriman planted and hoed six acres, worth $528, at an expense of $17 55; and Mr. George F. Moody planted and cultivated two acres, worth $142, at a cost of $3 75. The planting and hoeing, with man and horse, was in each case at the rate of 30 cents per hour. In the case of two farms in Virginia of equal fertility, one worked by a man and two boys with improved machinery, the other by seven men without labor-saving machinery, the former made larger gross returns than the latter.

While stock-growing may be less profitable than in the West, there are numerous examples of profitable dairying, the raising of butchers' lambs, and other specialties of stock-farming, to show that there is no necessity for the decay of the hill-farms, the transformation of pastures to ferneries, and the decline of production. The English system of husbandry, modified judiciously by local circumstances, has increased fertility, production, and profit, wherever introduced into New England. It is a fatal error to permit a retrograde; if high farming will not pay there, no farming will pay; if fertility cannot be advanced, the capital necessary for improvements employed, the use of labor-saving implements increased, it would be better to quit farming entirely and grow forests for the use of future manufacturers of wooden-ware. But there has been progress in many directions, and may be, we believe will be, generally, in the future. It only requires courage, a cold shoulder to croakers, energy, skill and application; and when the best lands of the distant West are taken up, as they soon will be, and prices there advance, young men of New England may be content to stay at home and enjoy the advantages of markets which fully counterbalance the fertility of western lands a thousand miles away from the mouths to be fed by their products.

STATUS OF VIRGINIA AGRICULTURE IN 1870.

It is believed that no State of the American Union enjoys greater natural advantages for the production of a great variety of the fruits of the earth than Virginia. Situated in the most favored parallels of the temperate zone, with a wide diversity of soils, and blessed with a climate for the most part eminently salubrious, it is capable of meeting the requirements of every variety of rural taste, and of sustaining a dense population. If farmers, in the history of the past, did not accumulate large fortunes, they were, as a rule, in easy and independent circumstances; and though the soil might not in many cases have been brought up to the highest state of productiveness by a course of systematic tillage, it never failed to respond generously to kind treatment. In some sections of the State, where the planting interests predominated, the culture was often carried to an oppressive extent, and exhaustion, more or less, was the consequence. But good lands were abundant and cheap; and, while fresh inroads might have been too often made on the primeval forests, the rejected fields, where the soil had not been carried off by washing, immediately sent forth a second growth, under which, in the course of one or two generations, they nearly regained their original

fertility. When, however, we consider the length of time the older parts of the State have been under cultivation, and the large proportion of good arable land still remaining, even under the system of annual cropping for more than a hundred years, we have convincing evidence of their extraordinary agricultural value.

The agriculture of Virginia was conducted in strict accordance with the traditions of the fathers until a period within the memory of many now living. The old methods, transmitted from sire to son almost since the first settlement of the colony, underwent scarcely any change. In fact, the proprietors of large estates felt but little incentive to improvement as long as recourse could be had to the virgin soils, which admitted of being brought into cultivation at less expense than the old could be restored, or even kept up to a productive standard. It was not until the first Virginia agricultural society was formed, about the year 1822 or 1823, and such men arose as Colonel John Taylor, of Caroline; Wilson Cary Nicholas, of Albemarle; and Richard Sampson, of Goochland, with a few other eminent farmers in other parts of the State, that any general impetus was given to improvement. By their writings, and not less by their example, public attention was aroused to the necessity of a change. Colonel Taylor's "ARATOR" was perhaps the most popular work of the kind ever published in the South. It originally appeared in short papers in the Richmond Enquirer. These were subsequently collected into a small volume, which ran through many editions, and was read by all classes. If it misled some of its readers, as it undoubtedly did, it excited a spirit of inquiry, which led to valuable results in the end. If we were called on to designate the fathers of modern Virginia agriculture, we should have no hesitation in fixing on these three illustrious individuals—Colonel Taylor, as a writer; Mr. Sampson, as the most successful practical farmer the State has ever produced; and Governor Nicholas, in the double capacity of writer and practical farmer, who infused enthusiasm into the bosoms of all with whom a long public life brought him into personal association. Mr. Sampson, living near a great public thoroughfare, attracted visitors from all parts of the State, who went to see the wonderful improvement he had effected.

The spirit of improvement thus excited went on, gradually expanding and gathering strength, until the great political convulsion which culminated in the disruption of the labor system of the State, causing a shock to its material prosperity from which it will necessarily take long years of struggling to recover. A revolution so sudden and so overwhelming could have no other effect than to paralyze for the time every industry in those districts where the former labor system prevailed to a large extent, and to derange it in some degree everywhere. The State was thus thrown back in her industrial career, but it is gratifying to notice that the people have met the crisis with admirable fortitude; and there is the best reason for believing that a change—the beginning of which is already perceptible—will ultimately be wrought in the habits of the white race, the possessors of the soil, and prove eminently salutary and beneficial. Another effect will be the disintegration of the overgrown and unwieldy plantations, and their subdivision into small farms. A hundred years are but a small period in the life of a nation, and though the present race of farmers may not witness the change, the second or third generation will live to see this grand old State dotted over with thousands of happy abodes, and her fair surface literally transformed into a garden. Such is the picture that will assuredly be presented when the great natural advantages of the country are developed to their full extent.

Before proceeding to describe the present condition of the agriculture of the State, it is proper and necessary that some reference should be made to its physical geography. In a general, and in some sort a political sense, two great divisions east of the mountains, and embracing diverse interests, are popularly recognized, called respectively the NORTHSIDE and SOUTHSIDE, the separating line being the James River. In the northern division, with the exception of a few counties bordering on the James, it is a farming country; in the southern division, a planting country. Each of these sections admits of two subdivisions, possessing very distinctive features: The tide-water region, lying between the head of tide and the ocean; and the Piedmont region, embraced between the head of tide and the Blue Ridge. Furthermore, between the Blue Ridge and the Alleghanies, a fine district of country, known as THE VALLEY, is situated, mostly on the north side of the James, but still extending some distance south of it. And lastly, there is the transmontane or SOUTHWEST VIRGINIA, exhibiting marked characteristics of its own. Each of these divisions is distinguished by its peculiar system of agriculture, having some things in common indeed, but each differing from the others in its leading industries. For the sake of perspicuity we shall consider them separately, accompanying them, respectively, with brief descriptions of their geographical features and the productions more particularly adapted to their soils.

In but few sections of the State has agriculture made any progress within the last ten years; almost everywhere, in fact, it has actually retrograded. The conditions on which agricultural prosperity rests have been so unsettled by intervening events, and the tenure of lands to a great extent rendered so uncertain, that few farmers have been influenced by a spirit of improvement. The great object has been to make a livelihood. To do this the lands have been taxed to their utmost capacity. Fertilizers have indeed been used freely, but rather with a view to speedy returns than ultimate improvement. No systematic rotation has been practiced; no course of amelioration steadily pursued. The efforts both of farmers and planters have been vigorous indeed, more so perhaps than at any former time, but spasmodic, looking to the present more than to the future. Considering the altered circumstances of the people, the productions of the soil in everything but wheat have borne favorable comparison with those of former years; in quantity, however, more than in quality. Of tobacco, for instance, the crop of 1870 was one of the largest ever grown in the State, but in its preparation for market it has been worse handled than any for many years. All but the old experienced planters appear to have lost their skill, and the crops of the latter formed but a small proportion of the whole. Throughout the tobacco region the crop is cultivated on nearly every farm, to a large extent by freedmen on rented land or on shares. It has thus fallen into many hands instead of being chiefly limited to the large plantations as formerly. In this way Virginia tobacco is fast losing its prestige, and the western tobacco is supplanting it in the markets of the world. In regard to cotton, also, the production has much increased, the last crop, like that of tobacco, being the largest, perhaps, ever grown in the State, but it has been produced very much to the neglect of the grain crops.

In the cotton and tobacco districts, though the planters have shown commendable industry, have been frugal in their personal expenses, and have worked with their own hands, it cannot be said they have prospered. They are still wedded to old habits, from which no change of circumstances has sufficed to divorce them. The painful experience of

1870—abundant crops and unremunerative prices—will not have been dearly purchased if it should only teach them to practice a more diversified system of husbandry.

In attempting, therefore, to sketch the state of agriculture in Virginia for the year 1870, we do it rather for the purpose of establishing a landmark from which future progress may be measured, than with a view of claiming that any progress has been made since the change in the social relations of the people. We are happy to believe, however, that there are indications of the dawn of a better period. We perceive it in the numerous agricultural societies which have been reorganized; in the large attendance at all the agricultural exhibitions; and in the increasing demand for agricultural literature.

Before entering on particular details, it will render the treatment of our subject more intelligible and systematic by prefacing it with brief descriptions of the several geographical divisions of the State.

I. NORTHSIDE VIRGINIA.

1. *Tide-water district.*—Well adapted to the production of the grains and grasses; a farming in contradistinction to a planting country. It embraces a large proportion of fertile lands, and in several localities shell-marl is found abundantly, which is readily accessible. It is intersected by several large, navigable streams, by means of which all the leading markets of the North are brought to the doors of the people. Its situation is within the limits of James River on the south, Chesapeake Bay and the Potomac on the east and northeast, and the Richmond and Washington Railroad on the west. It includes the counties of Henrico, (in part,) Hanover, (in part,) King William, Charles City, New Kent, James City, York, Warwick, Elizabeth City, (the four last named forming the tongue of land called the Peninsula;) Caroline, (in part,) Essex, King and Queen, Middlesex, Gloucester, and Matthews, (lying between the York and Rappahannock;) and King George, Westmoreland, Northumberland, Lancaster, and Richmond, composing what is termed the Northern Neck, and lying between the Rappahannock and Potomac Rivers. Portions of Prince William, Stafford, and Fairfax also belong to this district; and Accomac and Northampton, on the Eastern Shore, are to be included in it for all practical purposes. During the last years of the war great numbers of negroes were settled in the Peninsula, which has continued to be occupied by them, in chief part, down to the present time.

2. *Piedmont district.*—Eminently a grain and grass-growing region, extending from James River to the Potomac, and from the Blue Ridge to the western limits of the tide-water district. It embraces a great variety of soils, the northern tier of counties lying along the foot of the Blue Ridge being peculiarly adapted to grazing, and the more southern and eastern to grain and tobacco. The counties belonging to this division are parts of Henrico, Caroline, Hanover, and Stafford; Goochland, Fluvanna, Nelson, Amherst, and Albemarle, (in which five counties tobacco enters to considerable extent into the system of culture;) Madison, Orange, Spottsylvania, Culpeper, Rappahannock, Fauquier, Loudoun, and parts of Prince William and Fairfax.

II. SOUTHSIDE VIRGINIA.

1. *Tide-water district.*—Lying between James River and North Carolina on the north and south, the Atlantic Ocean on the east, and the Petersburg and Weldon Railroad on the west. The leading crops are cotton, peanuts, and corn. The sweet potato is also cultivated exten-

sively, particularly in localities having convenient transportation to the northern markets. Great numbers of hogs were formerly raised in the counties adjacent to the Dismal Swamp, from which was made the finest quality of Virginia bacon. The business is still pursued to some extent. In the neighborhood of Norfolk are the largest vegetable and fruit gardens in the South, which for the last thirty or thirty-five years—perhaps longer—have been supplying the northern markets with early fruits and vegetables, until now the trade has acquired extraordinary proportions, and is still growing from year to year. The soils of this part of the State are, as a rule, light and easily worked; very fertile along the margins of the streams, and readily susceptible of improvement generally, from the inexhaustible beds of shell-marl lying within its limits, and but a few feet below the surface. It embraces the counties of Prince George, Surry, Sussex, Southampton, Isle of Wight, Nansemond, Norfolk, and Princess Anne.

2. *Piedmont district.*—This is, by excellence, the tobacco-growing region of Virginia. Leaf of fine quality for both manufacturing and shipping purposes is grown in several counties north of James River, and in one or two at the southern extremity of the valley; but the best descriptions, and always commanding the highest prices, are produced in this district, and more particularly in the counties bordering on and adjacent to the Blue Ridge. The general surface of the country is quite undulating, in many places hilly, with a soil for the most part naturally fertile, and resting on a strong red clay—in some places yellow. It abounds in springs and streams of the purest water. The soil is also well adapted to corn, wheat, and clover. The counties constituting this division are Dinwiddie, Chesterfield, Powhatan, Amelia, Nottoway, Lunenburg, Greenville, Brunswick, Mecklenburg, Halifax, Charlotte, Prince Edward, Cumberland, Appomattox, Campbell, Bedford, Pittsylvania, Franklin, Henry, and Patrick, a very large and important section of the State, extending from James River on the north to the Carolina line on the south, and from the Petersburg and Weldon road on the east to the Blue Ridge on the west. This is the only large division in the State in which the slaves formerly outnumbered the whites. There is still much disparity between the races in several of the counties; but owing to the gradual influx of settlers from the North, and the tendency of the blacks to move farther south, the numbers are becoming every year more nearly equalized.

III. THE VALLEY.

Naturally this is the most fertile region of the State, and, as it was only partially subjected to the blighting influences of slavery, it has ever been the most prosperous. It is the division in which the system of mixed husbandry has been most fully carried out. It is a superior grain and grass country, yielding bountifully of wheat and corn, and stocked with fine animals. Great numbers of cattle are fattened for the northern markets. The horses are generally of the heavy draught breed, attaining large size like the western animals. Sheep and swine thrive. Dairies abound in every part of the valley, and fine butter is the source of considerable income. Apple orchards are numerous. For the most part it is divided into farms of small size. The soils are to considerable extent calcareous, resting on a limestone formation. We see in the population only a small infusion of the old Virginia element, being composed chiefly of Germans and Scotch-Irish. Before the war more evidences of prosperity were exhibited here than in any other division of the State east of the Alleghany Mountains; and

though it suffered greatly during the struggle—the northern portion being almost desolated—it has shown a recuperative energy worthy to be imitated by the farmers of other sections.

The valley lies between the Blue Ridge and the Alleghany Mountains, and extends from the Potomac River on the north to New River on the south or southwest, stretching over nearly three degrees of latitude, and exhibiting much diversity both of soil and climate. The counties embraced within its limits are Frederick, Clarke, Shenandoah, Rockingham, Augusta, Highland, Bath, Alleghany, Rockbridge, Botetourt, Roanoke, Craig, and parts of Giles and Montgomery.

IV. SOUTHWEST VIRGINIA.

According to the political nomenclature of former times, this division of the State was generally called "Little Tennessee," but latterly it has been distinguished by the caption we have given. It is a mountainous region, abounding in fertile valleys, and preëminently adapted to stock and grazing purposes. The finest prize cattle exhibited at the eastern fairs—mostly Short-horns—are brought from this section; also the fattest beeves. Except in two or three counties, or portions of counties, the farmers are nearly all engaged in rearing stock. Hogs are raised in large numbers; and sheep, mostly of the improved long-wool breeds, are receiving much attention. It is destined to be, if not already, one of the finest stock regions in the United States. Plaster of the finest quality abounds in Washington County, and is extensively used. The Kentucky blue-grass is a natural growth, and all the cultivated grasses succeed to perfection. Southwest Virginia may be defined as extending from New River to the Kentucky and Tennessee lines, and embracing the counties of Montgomery and Giles, (in part.) Pulaski, Bland, Wythe, Tazewell, Smythe, Washington, Russell, Scott, Lee, Wise, Buchanan, Grayson, Carroll, and Floyd.

The agricultural resources of Virginia have always been great, and her rich and varied productions have constituted an important element of the national wealth since the foundation of the Government. After the sudden shock to her labor system, at the close of the late war, it was thought desirable to ascertain the present condition of her agriculture; what modifications it had undergone since that event; and what were the prospects of renewed and increasing prosperity. With this view the Department prepared a circular in the fall of 1870, and forwarded copies to its regular correspondents in the State, and also to other gentlemen, two or three in each county, so far as it was practicable at the time to obtain the names of trustworthy and intelligent farmers. The result has been the accumulation of a mass of interesting materials sufficient to give a very fair exhibit of the object sought. The points on which information was solicited are embraced in the following inquiries:

1. Is increased attention given to a judicious alternation of crops, with the intervention of green crops? A clear statement of the course of rotation, in a representative example, with results obtained, will be desirable in illustration.

2. To what extent have labor-saving implements been made a substitute for manual labor? Give facts showing the profit of such substitution.

3. To what extent are fertilizers applied? What proportion of tilled acreage is fertilized? What rate of application per acre? What the relative proportions of commercial and home-made fertilizers, and comparative results of each? What kinds are found most economical, and how much is production increased by the application? Give illustrative facts.

4. Are farm animals increasing; and if so, what species, and what breeds? Is improvement of farm stock engaging attention, and to what extent?

Following the geographical distinctions as already sketched, we proceed to give the substance of the answers to our inquiries according to the order in which they were propounded.

ROTATION OF CROPS.

Tide-water district, (*Northside*.)—In the counties near Richmond some attention is being paid to this subject, but not so much as before the war. The usual system of rotation in Henrico, as far as any prevails, embraces five shifts—corn, oats, wheat, clover, wheat; or corn, wheat, clover, wheat, pasture. Timothy is gaining ground, and when hay is the object the farm is divided into eight fields, each field yielding three crops of hay during the course. This is considered the most profitable system of farming. In New Kent clover is generally used as a green crop, allowed to stand one year, and then followed by corn. In Charles City the subject receives no attention, the farmers having many of their former slaves living on their lands and cultivating on shares, which prevents due regard to improvement. In King William the five-field system is preferred, both for profit and improvement, the course being wheat, clover, pasture, corn, oats. Pea fallow is a favorite preparation for wheat by some farmers. In York no attention is paid to the subject, and this remark applies to the other counties forming the Peninsula. No progress of any kind is made, but the movement is backward. The negroes constitute four-fifths of the population, who cultivate a large portion of the land, either on shares, or for a money rent. They raise no crop but corn, the average yield of which is about six bushels to the acre.

Crossing York River, and its tributary, the Mattapony, we first enter King and Queen, where an excellent system of husbandry was formerly practiced. The farmers are returning to it as fast as they are able. The field-pea is mostly used as a green crop for wheat, and invariably with success. The rotation preferred is corn, manured with home-made manure on one-half of the field, and on the other peas are sown at the rate of one bushel to the acre in May or early in June. In September or October the entire field is seeded to wheat, and the pea fallow is always the best. In three years the same field comes into cultivation again, when the treatment is reversed. This is regarded as a fine rotation, and the land improves rapidly under it. In some parts of the county the Maggothy Bay bean (*Cassia chamæcrista*) grows spontaneously, and makes a rich return to the land in a green crop. Lands improve under it even when cultivated in corn and oats in alternate years. In Essex no increased attention is given to a judicious alternation of crops. Very few farmers practice any regular course.

Leaving this range of counties and crossing the Rappahannock, we come into the Northern Neck, one of the classic localities of the State, rendered memorable as being the birthplace of Washington and other illustrious Virginians. Its agricultural capabilities are very great, but in common with other portions of the State it received a severe shock to its prosperity. King George: No increased attention is given to alternation of crops, green crops being the exception, and seen on only a few of the best plantations. The four-field system was the one formerly in general use, wheat being seeded on a clover fallow, followed by corn, and then wheat or oats. With the use of clover and gypsum the productiveness of large fields was raised to fifteen and twenty

bushels of wheat to the acre, and fields of smaller size to thirty and forty bushels. Farmers are endeavoring to return to this system, but the progress is slow. From Richmond we have reports of increasing attention. The five-field system is practiced, sowing wheat on clover fallow, following with corn, then oats and clover, cutting the clover two years for hay. Northumberland: A few farmers have adopted the three-field system with excellent results. First year, wheat with one hundred and fifty to two hundred pounds of guano and seeded to clover in the spring; second year, clover partially grazed and limed or marled; third year, corn. Very good crops of wheat are grown on a clover lay without guano. Lancaster: Increased attention is given to alternation of crops. Many large farms that were formerly cultivated on the two and three-field system are now subdivided into five or six fields, with a rotation of grass crops, by which a large farm may be cultivated with half the manual labor formerly employed, when grain crops were exclusively raised.

Piedmont district, (Northside.)—Gradually emerging from the tide-water counties proper, we come first to Stafford, in which we learn the following rotation is practiced by many farmers: Corn, wheat, and clover in succession, the last plowed in after the third crop, and then wheat and clover again. In Prince William but little attention is given to alternation, owing to the impoverished condition of the farmers. Alexandria: Farmers are using green crops; course of rotation, corn, wheat, rye or oats, and grass (clover or timothy) with very satisfactory results. Fairfax: The attention given to alternation of crops is probably not increasing, the rotation before and since 1860 being usually corn, oats, and wheat; then clover and timothy for two or three years, and in particular cases five or six years. Under this system, with the judicious application of fertilizers and farm-yard manures, lands in the western part of the county have risen in value from $20 to $40 per acre, and their productive capacity increased from fifteen or twenty bushels to forty bushels of corn per acre; oats from ten bushels to twenty-five or thirty bushels; hay, three-fold. Wheat has been an uncertain crop for several years. Caroline: To a limited extent increased attention is given to alternation of crops; as, first a crop of corn or tobacco, then wheat or oats, then clover, with rest for a year. The yield of the succeeding crops is increased at least 10 per cent. Louisa: Less and less attention during the past five years has been given to green crops. As far as any system of alternation is practiced, it is corn, wheat, and clover, the clover fallowed the following year for tobacco, then wheat, clover, and corn. Lots treated in this way, with alternate use of one hundred and fifty pounds of guano per acre and coarse stable manure, are very productive.

We now enter the tier of counties lying along or near the base of the Blue Ridge. Loudoun: Considerable attention is paid to rotation, which is usually to turn down a sod for corn, the yield (taking the county over) being about thirty bushels to the acre; wheat after corn, with a return of about eight bushels per acre; then wheat again, with clover the following year, to stand two or three years, and mowed or pastured at pleasure. A clover fallow will produce about sixteen bushels of wheat per acre. In the southern part of the county grazing is the principal industry, which is pursued in much the same manner as we proceed to describe in the adjoining county of Fauquier: This is preëminently a grazing county, particularly the upper or northern part, and therefore admitting of an endless variety of rotation, with the intervention of green crops, all subsidiary to the main pursuit. The land, when left uncultivated, clothes itself readily (without seed) in blue-

grass, which forms a sod that improves each year, so that when thirty years old the pastures will turn off beef better fattened than when younger. Many farmers devote a large portion of their estates to perpetual sod, dividing the remaining portion into six, seven, or eight fields, with alternations of clover and timothy. Others take a field after it has been in sod six or more years, and has become so enriched as to bear a succession of crops for as many more years. The general result is, that in few parts of the State have the lands been so much improved, or more numerous instances of well-paid agriculture been presented. Madison: A rotation of crops has prevailed for many years, though not always, or generally, with the intervention of green crops. The plan preferred is the six-field system; corn, fallowed with oats, then wheat, with clover and timothy the ensuing three years. Greene: No general attention is paid to a judicious alternation of crops, but the seeding of clover and timothy is on the increase. The most approved course is corn, then wheat or oats with grass-seeds; the second crop of grass to be fallowed and seeded to wheat, and afterward to remain two years in grass. Under this system fields which some years ago would not yield more than ten bushels of corn to the acre now produce thirty to fifty bushels. Culpeper: Partly a grazing and partly a grain county. The rotation followed by the best farmers is corn, wheat, and clover, (or clover and timothy mixed,) if grazing more than improvement of the land is the object. As a general thing, however, but little attention is paid to a regular alternation of crops. Albemarle: The rotation usually practiced is to fallow a green crop, and seed the land to wheat which, without fertilizer, yields from fifteen to twenty bushels per acre; after wheat, corn, making twenty-five to thirty bushels per acre, and then wheat or oats. If wheat, an application of one hundred and fifty to two hundred pounds of fertilizer is given, and the yield is fifteen to twenty bushels per acre; if oats, no fertilizer is applied, and the yield is twenty to twenty-five bushels per acre. Then fallow with grass for two or three years. Upon the whole, however, this great central county of the State is making but slow progress in improvement. Nelson: Increased attention is given to alternation of crops. The course usually adopted is to cultivate first with corn, then oats, then wheat, and to fallow with two years in clover, requiring five years to complete the rotation.

Tide-water district, (*Southside*.)—This is the smallest geographical division of the State, embracing only six or seven counties, the productions of which, as well as the neglect of all scientific methods of culture, are peculiar to itself. The staple crops are cotton, peanuts, corn, oats, sweet potatoes, and cornfield peas. In one or two counties very extensive apple and peach orchards are planted, and the "brandy crop" is spoken of as familiarly as any other crop. In Norfolk, and one or two other counties convenient to water transportation, trucking and the raising of fruits for the northern markets are largely followed. We have reports from five or six counties, and the subject of rotation and alternation may be dispatched with brief notice. Surry: No increased attention, and scarcely any at all is given to rotation. The method of cropping is about as follows: First year, corn, with cornfield peas sown broadcast or planted in hills between the corn rows at last plowing; second year, the land lies fallow, unless planted in peanuts (now generally the case) or sown with oats. The truck patches are generally on land planted with corn the preceding year; third year with corn again, and so on. Southampton: No system of alternation pursued. The attention of farmers is directed to the production of cotton, which is

planted on the same land annually and indefinitely. Isle of Wight: No attention to any judicious alternation of crops, the object of farmers being to cultivate that crop which will bring in most money, without regard to improvement. No attention is given to green crops. The usual course is the three-field system—corn, oats, and peanuts—which is regarded as ruinous. Princess Anne: Corn and oats are the principal crops. These alternate, except when the land is permitted to rest, that is, to grow up in weeds and natural grass, which are turned under in the winter for corn again. No green crops. Norfolk: This being a horticultural rather than an agricultural county, we give some statistics of its production and trade: Number of acres cultivated in fruit, about 4,000; in trucking, about 20,000. Shipments of fruit and truck, in 1870, averaged at least 10,000 packages daily, and for one hundred days amounted to about 1,000,000 packages, the estimated value of which was fully $1,500,000. Freights realized by the carrying trade, $350,000. The grape business is yet in its infancy, only about one hundred and twenty acres being in cultivation; but experience bids fair for the most flattering results, especially in wine-making.

Piedmont district, (Southside.)—According to the divisions we have adopted, this is the largest in the State. Chesterfield: The plan adopted and generally coming into use for rotation is, first, corn, then wheat or oats, followed by clover or peas, the latter preferred on light soils; clover on stiff soils. In every instance, when properly cultivated, marked improvement in the land is observable, the increase of production being five to fifteen bushels of wheat per acre. Powhatan: Increased attention paid to the alternation of crops. Clover is the only green crop raised to any extent. It is generally followed by wheat; sometimes on a small scale by tobacco. The people are slowly rallying from their depression, and adopting the policy of working less land and making it rich. Cumberland: Farmers gradually, though slowly, improving their system of culture, and a judicious rotation is being generally introduced. The summer crops of corn and tobacco are followed by wheat; the wheat by clover for one or two years. Properly carried out, a rapid improvement of the soil is visible. Amelia: The report is substantially the same as from Cumberland. Lunenburg: Agriculture is at a low ebb in this county. Little or no attention is paid to a judicious alternation of crops, on account of the straitened circumstances of the people. Nottoway: This was formerly a highly cultivated county, and the farmers in prosperous circumstances. As a general rule, but little attention has been given latterly to a rotation of crops, but in some instances farmers are dividing their lands into three, four, or five fields, cultivating them in turn, and alternating with clover and the grasses. Appomattox: No attention to rotation of crops. Buckingham: Slightly increased attention is paid to alternation of crops, and farmers are beginning to return slowly to their former methods. A large crop of wheat was seeded in the fall of 1870, followed by a general inquiry for grass-seeds. Campbell: Nothing being done toward an improved system of culture. On the contrary, the best lands are severely cropped to meet the immediate wants of their owners. Charlotte: Not much attention paid of late years to alternation, with the intervention of green crops. Prince Edward: Farmers are adopting the four-shift system; first, tobacco or corn, followed by wheat; wheat, by clover and timothy, and one year in pasturage. Under this system the lands are kept up to their original fertility. Tobacco the leading staple; average yield per acre, one thousand pounds; corn, thirty bushels; wheat, fifteen bushels; oats, twenty-five bushels. Pittsylvania: Very little increased attention to a judicious

rotation, or to the intervention of green crops. This is one of the leading tobacco counties, and the system of cultivation pursued ends in total or partial exhaustion in five or six years. On almost every farm there is a large extent of uncultivated land. Franklin: This is another great tobacco county, and wherever this staple is largely cultivated it is accompanied by few evidences of improvement; but a considerable portion of the county is adapted to grain and grass, and there increased attention is paid to a judicious rotation. The green crops consist of clover and orchard-grass mixed, and are generally allowed to stand for three years. The best lands are mowed annually for hay, which is of excellent quality. At the end of the third year the land is deeply fallowed, and either seeded in wheat or rye or planted with corn or tobacco. Large quantities of Smythe County plaster are used. Patrick: This is another tobacco county, situated in a remote and retired region, with no market facilities. The system of farming is rude and primitive; hence no attention is given to alternation of crops; the term is hardly appreciated. Notwithstanding these features, the value per acre of farm products will compare favorably with that of any other section of the State.

The Valley.—Clarke: No increased attention paid to alternation, with or without intervening green crops, but rather a falling off. Farming is mostly carried on by tenants, under no particular system of rotation, and no calculation of results. Augusta: One report states that some increased attention, and another that but very little, is paid to the use of green crops for the improvement of lands. The usual rotation is corn, oats, wheat, and then grass. Rockbridge: The farmers seem alive to the importance and desirability of a judicious alternation of crops, and especially of the utilization of clover with a view to improvement; but owing to their depressed condition they are making but little progress. Highland: This is a mountainous region, and better adapted to grazing than grain crops; hence the chief occupation is to fatten cattle for the northern markets. The same remarks will apply substantially to Pendleton and Bath. Botetourt: Farmers are just beginning to improve their lands by a regular intervention of green crops. They find it pays better since the decline in breadstuffs and advance in labor. Roanoke: The alternation of crops, with the intervention of green crops, has been practiced for many years, though much interrupted by the war. Red clover is the green crop mostly relied on as an improver. The four or five field shifts are the usual rotation, which is so well understood by farmers as to need no illustration. Tobacco for shipping purposes is generally raised on manured lots or rich bottom lands.

Southwest Virginia.—Montgomery: Increased attention is given to rotation. A favorite course is to fallow an old clover sod for wheat, follow with corn, then oats, with clover and the grasses again—to remain four or five years in grass, in which the land will yield as great, or perhaps a greater, net income, by means of stock-grazing, as during the years of cultivation. The county offers a wide range of choice for agricultural productions. The valleys between the spurs of the Alleghanies produce the finest quality of manufacturing tobacco. Pulaski: No attention given to rotation of crops. A grass county, owned in large part by wealthy men, and devoted to stock-raising. Wythe: Another grass county, and, the grazing of stock being the principal business, the course of rotation is adapted to the production of the greatest amount of grass. Bland: Increased attention paid to rotation. The course is generally corn, (on sod,) wheat, and oats, which bring the land in good condition for grass. Carroll: Farmers are beginning

to pay more attention to rotation of crops, with the intervention of green crops; but as the county is better adapted to grazing than to grain culture, the people only aim to produce grain sufficient for home consumption. Grayson: Decidedly more attention given to a judicious alternation, with the intervention of green crops. The rotation is as follows: A sod is broken up and planted in corn; the next spring seeded in oats, and in the fall in wheat; the spring following, in clover and grass, which is generally mowed the first year for seed, and then allowed to remain in sod three to five years. The main business is stock-raising, horses and cattle being preferred. Cattle, both in number and quality, are far in excess of what they were five years ago. Washington: Increased attention given to rotation, with green crops. This is both a grazing and a grain county. The soil is very productive, yielding with an annual dressing of plaster and ashes (half bushel of each to the acre) three tons of hay per acre each year while it remains in grass, which is usually for three years. Wheat (drilled) on a clover sod produces twenty bushels per acre: corn, (which succeeds wheat,) fifty bushels; and oats, (coming after,) fifty to seventy-five bushels. Scott: This being also a grazing county, the statements given above are in the main applicable to its condition.

LABOR-SAVING IMPLEMENTS.

Tide-water district, (Northside.)—Henrico: Every farmer able to do so is using implements as a substitute for manual labor, as the substitute is found to be profitable. The chief bar to a more general use is the want of intelligence among the laborers. Wherever grass is grown for hay, the mower, horse-rake, and hay-fork are brought into requisition, at a great saving of both labor and expense. Charles City and York: Little or no use made of improved implements. New Kent: There are a number of northern settlers in this county, who have introduced Potts's separator, McCormick's reaper, Buckeye dropper, and some other machines. A marked improvement is observable in the county since their introduction. King William: Labor-saving machines have been eagerly sought after, and tested by many farmers. Thrashers, with separating attachments, reapers, corn-planters, and cultivators, are extensively used. The separator is considered a great saving of labor; a good reaper does the work of eight men with cradles; a corn-planter saves the work of eight hands; the sulky-plow succeeds well where the land is in good condition. Essex, and King and Queen: The condition of the people is so impoverished that they have not been able to avail themselves of improved machinery. The only implement which has been tried is the buggy-plow, and it proved a failure. King George: On some of the large plantations, wheat-drills and reapers are used, and in all cases with advantage; also, mowers and horse-rakes. Richmond: "Reapers, mowers, drills, gleaners, and stump-pullers are in use. A reaper will do the work of three to five men; a mower, of six to eight men; a drill, of five one-horse plows; a gleaner, or steel-tooth rake, of twenty men, and in a better manner. Two men, with a stump-puller, will do the work of ten men with grubbing-hoes. In cost of labor, machines save 75 per cent." Lancaster: Sulky plows and cultivators have been introduced with marked advantage. A number of wheat-reapers and mowers are now used, which reduce harvest expenses one-third.

Piedmont, (Northside.)—Stafford: Reapers, mowers, and horse-rakes are used extensively, and with considerable saving of money and labor. Prince William: Reapers and mowers, with other implements of less note, are being gradually introduced. Alexandria: Improved machinery

used to a very great extent. It is seen in the wheat, rye, and oat fields of every farmer, in the seeding, thrashing, and cleaning of small grain and the cultivation of crops. Fairfax: Surface of the country well adapted to labor-saving implements, and they are generally in use for cutting grain and grass. Caroline: Want of means, and want of confidence in their durability, have prevented farmers from using improved implements, except in a very limited way. Louisa: No experiments have been made to test the merits of new machinery. Labor is so cheap that farmers have felt no inducement to try new methods. Loudoun: The reaper, mower, drill, and rake are in general use, the mower cutting eight to ten acres per day, and the rake, with a brisk horse, going over twenty acres. Fauquier: Nearly every kind of labor-saving implement has been tried, and all with decided profit, except reapers, much the larger portion of the county being too hilly for their use. The mower (McCormick's preferred) is used on all the meadows. Madison: Wheat-drills, reapers, mowers, and thrashing-machines are extensively used, and have become indispensable on large farms. Greene: The mower used to some extent, but, not being a wheat-growing section, the drill and reaper have not been introduced. Culpeper: To a largely increasing extent, labor-saving machinery has taken the place of manual labor, and the substitution has been found profitable. Its general use has only been prevented by the poverty of the people. Albemarle: Labor-saving machines not much used, for the reason that the prices are beyond the means of most farmers. Nelson: Improved implements used to a very limited extent. Where the surface of the land is adapted to them, corn-planters, buggy-plows, reapers, mowers, and gleaners have been tried to advantage, and save 30 to 60 per cent. of manual labor.

Tide-water, (*Southside.*)—Cotton and peanuts being the principal market crops, with corn, the only implements in use are such as are specially adapted to their culture. So far as relates to what is generally understood by the term "improved implements," the answers from Surry, Southampton, and Isle of Wight agree in saying, "None worth mentioning." In Princess Anne, the corn-weeder or cotton-plow, for cleaning young corn, is in general use, doing the work of three hands with hoes, and nearly as well. In Norfolk various implements are used, adapted to horticultural purposes.

Piedmont district, (*Southside.*)—A large and very important division of the State, but, except in one or two counties, no enterprise has been manifested in the introduction of improved implements. In Chesterfield, the want of capital has prevented their more extended use. The small number that have been tried have given satisfaction. In Powhatan, the drill, reaper, and mower are in use on the large James River farms. As a general thing, labor is cheap and abundant, such as it is. In Cumberland and Lunenburg, farmers still follow the old modes of culture. In Amelia, corn-planters and drills are used to some extent, but this county is rousing up from its lethargy, and a working agricultural society, of more than a hundred farmers, has been organized during the year, from whose labors we may expect useful results. In Nottoway, where a number of northern men have bought farms, drills, mowers, reapers, and thrashing-machines have been successfully introduced by them. In Appomattox, the land is thought to be too rolling to admit of their profitable use. In Buckingham, not a single improved implement has been introduced, with the exception of one reaper, which was put in operation last harvest and gave satisfaction to those who witnessed its performance; but, as a large crop of wheat is reported to have been seeded in the county in the fall of 1870, the use of reapers

will probably be extended. In Campbell, a few instances of the introduction of labor-saving machines are reported, but generally attended with disappointment. In Charlotte, none in use; and in Pittsylvania, to a very limited extent. From Prince Edward, where the farmers have been long noted for their enterprise, we learn that several reapers were introduced during the year, and as the surface of the country is highly favorable to their use, it is believed the number will be increased from year to year. Improved plows are taking the place of hand-hoes on almost every farm. In Franklin, improved implements are being used to a limited extent, and would be largely if the lands were not too rough to justify their adoption. In Patrick, "labor-saving machines are looked upon with suspicion and distrust" by the rural population of this secluded county.

The Valley.—In this fertile and highly cultivated district, labor-saving implements are coming into very general use. The only exception reported is in Clarke, where they have been introduced to only a limited extent; but farming in this county is carried on mostly by tenants. Augusta: A very considerable increase since the war, and as much as 25 per cent. within the past year over the preceding year, but no test, by way of comparison, seems to have been made to show the advantages resulting from their use. Rockbridge: Manual labor has been supplanted, to a large extent, by the drill, reaper, mower, corn-planter, sulky-rake, and other improved implements, which have been introduced all over the county in increasing numbers every year. It is claimed by some farmers that the labor of eight men is saved every day that a mower or sulky-rake is worked to its full capacity. "A recent discussion on this subject, held by the N. R. Club of Rockbridge, resulted in the conclusion" that "the time to ignore the use of such contrivances has long since passed." Highland is well supplied with mowers, and to some extent with buggy-rakes and thrashing-machines. Improved household machinery is also coming into use. Botetourt: Labor-saving implements are extensively used, and with the most satisfactory results. As an illustration, "Mr. G., with two boys, puts up more hay than Mr. R., with seven hands; and grows more corn, wheat, and tobacco, and sells considerably more. The only difference is that G. uses improved implements and R. manual labor." Roanoke: Reapers, mowers, drills, horse-rakes, corn-shellers, cutting-boxes, and in fact nearly every kind of improved implement, have been introduced throughout the county, and with marked benefit. "With the mower, one hand with two horses will do as much in one day as eight or ten ordinary hands, and the hay-rake, with one horse, as much in proportion. The reaper, with one hand and two horses, will cut as much in a day, in heavy grain, as four men with scythes. The wheat-drill not only saves labor in seeding, but leaves the land in better condition for the crop. The buggy-plow, with one hand and two horses, does nearly as much in a day as four men and four horses in the former way of plowing, and so with all other machinery now used on the farm." The only complaint is that the improved machinery costs too much.

Southwest Virginia.—Montgomery: "Since the change in the labor system of the county, the demand for labor-saving machinery of all kinds has increased. Mowers of different patents have been introduced with great success. Accompanied by the horse-rake, they are now regarded in the light of an agricultural necessity. Reapers are used, but they are not so well suited to the rough and uneven surface of the country. For this reason, and on account of their cost and liability to injury in unskilled hands, they will not soon take the place of the cradle.

Separators of the latest style have been freely introduced, and are superseding the old thrashing-machines to a great extent. Corn-planters and wheat-drills are also used with very satisfactory results." "Perhaps half the hay made in the county is cut with mowers. In some cases, parties make it a business to go from farm to farm and cut on shares." Pulaski: Owing to the want of means, and other causes, labor-saving implements are used to only a limited extent. Wythe: Reapers and mowers have been introduced, but not many other improved implements. Bland: Manual labor is being largely displaced by improved implements, which are rapidly growing in favor, as they perform the work of many men in a day, besides doing it in the proper season. Carroll: The surface of the country is too rough and broken to justify the adoption of reapers and mowers, but thrashing-machines are used exclusively for cleaning grain. Grayson: Most of the farmers have availed themselves of the use of mowing-machines and hay-rakes, without which it would be impossible to save the hay crop of the county. Fully one-half the expense of securing the crop is saved, as compared with the old method. Washington: "Within the last three or four years, labor-saving implements have been rapidly on the increase, both as to quantity and quality. Their advantage over labor by hand is wonderful. One man, with the improved plow, wheat and corn drill, a buggy-cultivator, mower, reaper, and horse-rake, will, in one summer, perform the labor of at least six good hands. In addition to these, other implements, of minor importance, are taking the place of hand labor to a great extent." Scott: With the exception of mowers and reapers, only a few labor-saving implements have been introduced.

USE OF FERTILIZERS.

Tide-water district, (Northside.)—Henrico: "Commercial fertilizers are now used only to a limited extent, the quantity purchased decreasing every year; but more attention is being paid to home-made manures. The use of pure bone-dust is increasing. About one-third of the land tilled is fertilized in some way; if with bone-dust or guano, about two hundred pounds to the acre; if with home-made manure, about four hundred to five hundred bushels to the acre. The home-made manure is much more valuable than guano, and quicker, though not so lasting, perhaps, as bone-dust; the effect of the one being immediate, the other not acting fully till the second or third year; product about doubled by the application of five hundred bushels of home-made manure or six bushels of bone-dust." Charles City: "Fertilizers are much used, and greatly on the increase; at least one-third of the tilled acreage has fertilizers of some kind applied to it." Several experiments go to show that with Whann's superphosphate, one hundred pounds to the acre, or fifty pounds with an equal weight of leached ashes, both applied to the hill, the yield of corn is increased from five to fifteen bushels per acre, the former being the product where none was applied. A shovelful of home-made manure produces about the same effect. New Kent: Guano is the principal fertilizer for wheat; ashes, plaster, and barn-yard manure, (with marl containing some greensand,) for corn. No attention paid to getting statistical results, though the improvement is marked in the action of guano on wheat and clover. Relative proportions of manufactured and home-made manures about equal. York and the Peninsula generally: "Fertilizers applied to an extent so small as not to admit of a definite reply." King William: "Manipulated manures are less extensively used than they were two years ago; the majority of them are regarded

by farmers as unmitigated humbugs. Peruvian guano is the best, and the kind generally used on wheat. Pea or clover fallow, on marled or limed land, yields a heavier crop than any commercial manure, besides leaving the land in better condition. Plaster is a favorite application on green crops. Farmers are turning their attention much more than formerly to making manure in the farm-yard. Good stable-manure will double the yield of ordinary land." Essex: Commercial manures fallen almost into disuse. Home-made, including lime from oyster-shells and ashes from the fire-places, are regarded as far preferable, being more lasting, economical, and profitable. The use of lime and manure insures a rapid improvement of the soil, producing a luxuriant crop of clover and the grasses. King and Queen: Commercial fertilizers but little used, farmers having lost confidence in them. Increased attention paid to making and applying domestic manures. King George: "Fertilizers have been found of so little benefit that their use is yearly diminishing. Guano formerly produced astonishing effects, but not now. The manures of the farm-pen and stables are more regarded." Richmond: Manures are applied to crops of all kinds, but not one-tenth of the tilled acreage is manured? From one hundred to three hundred pounds of superphosphate applied to the acre, and twenty-five one-horse loads of home-made manure. The home-made always pays; commercial rarely. Lime and home-made manure are the most economical, and the production is doubled by the application. On limed lands the crops are increased 100 per cent. after three years. Northumberland: Not more than three acres in one hundred are fertilized with commercial manures, and the benefit is exhausted in one or two years. Latterly fish-guano has been introduced, which is manufactured in the county, and sold at $20 per ton. An application of three hundred to five hundred pounds per acre has produced fifteen bushels of wheat on land which would not have produced four bushels without it, and it promotes a vigorous growth of clover. Its effects are far more permanent than those of Peruvian guano. Clover and lime will make the poorest lands of the county as productive as may be desired. Lancaster: Commercial manures have been used on wheat and corn at the rate of two hundred pounds to the acre. Owing to the dry seasons for the last two years, the immediate effect was not appreciable, but the benefit to the young clover and grasses was marked. Home-made manures are more economical, and the county has vast resources for their production, in marl and oyster-shells, sea-ores, fresh and salt peat, woods' mold, &c. A single application of sea-ores has been known to increase the crop of corn fifteen bushels to the acre.

Piedmont district, (Northside.)—Stafford: Manufactured fertilizers have proved so uncertain that they were little used the past season. Home-made manures were more relied on. Prince William: Fertilizers are used on only a small portion of the tilled land, perhaps, one-fifth; half commercial, half home-made. Of the former, from two hundred to three hundred pounds per acre are applied. The home-made is far better in its effects, lasting several years, the commercial only benefiting the first and second crops. Alexandria: Fertilizers are applied to a very great extent, at least one-half of the tilled acreage being improved. Commercial and home-made in about equal proportions, the former at the rate of two hundred to four hundred pounds per acre. The increase of products is considerably in favor of home-made manure, and land is always left in better condition. Fairfax: Probably two-thirds of the land seeded to wheat and one-fourth of the corn have commercial fertilizers applied to them, at an average rate of one hundred and fifty pounds to

the acre. Barn-yard manure is husbanded with some care. It is deemed most economical to apply this to the fields nearest to the barn, and commercial fertilizers to those most remote. When the hauling does not add too much to the expense, barn-yard manure is the best for all crops, except wheat. Gas-lime is largely used in the portions of the county nearest to Washington and Alexandria, and is thought to be quicker in its effects than stone-lime or oyster-shells. Plaster is not sown extensively. Caroline: Fertilizers are applied to perhaps one in every five acres; commercial to a greater extent than home-made, but the latter are always the best, and in the end cheaper. Lands, however fertile naturally, will increase in product almost double by a liberal application of manures. Louisa: The reports from this county are somewhat diverse. One correspondent states that "within his observation bought fertilizers are less and less used." Another says that they are much employed, and that their use is limited only by the want of means to purchase. When such means exist, they are applied to three-fourths of the cultivated land. Peruvian guano is preferred, or those superphosphates of which it forms one of the component parts; or guano and bone-flour, in the proportion of two to one, at the rate of two hundred and fifty pounds per acre for wheat. Home-made manures are preferred, as far as available. Loudoun: Commercial fertilizers are almost exclusively applied to the wheat crop, embracing about one-third of the acreage, at the rate of one hundred and twenty-five to one hundred and fifty pounds per acre. This about doubles the product. Not more than one-fourth of the whole manure used is home-made. Fauquier: "Our grazing system supersedes the use of fertilizers, except plaster." Turner's Excelsior has retained the good opinion of farmers longer than any other fertilizer, being valuable for insuring a good stand of timothy. Plaster is universally used on grass, with good results. Turner's Excelsior, made in Baltimore, is used to a greater extent than all other fertilizers combined. At the rate of one hundred and fifty pounds per acre, it hastens the ripening of wheat about five days, and benefits the succeeding crop of clover 30 per cent." Madison: About one-twentieth of the tilled acreage is fertilized. Commercial manures are used largely in excess of home-made, and are thought by many to be the most economical. A mixture of equal parts of Peruvian guano and raw bone-dust, three hundred pounds to the acre, acts very finely on the cereals and grasses. Greene: The use of fertilizers is quite limited; home-made in much larger proportion than commercial, the former being regarded as most economical and profitable. Tobacco planters, of whom there are a few, hold on to the commercial manures. Plaster is used to a limited extent on nearly all crops. The soil is very susceptible of improvement, and a light application of manure produces an increase of about ten bushels of corn or other grain to the acre. Culpeper: Fertilizers are used to a limited extent on wheat. About one-tenth of the acreage is improved, half with home-made manures, and half with commercial, with similar results. Since the disappearance of the joint-worm, the production is increased eight to ten bushels to the acre by the application, making the average yield nearly twenty bushels, from one hundred and fifty to two hundred pounds of phosphate. Some farmers manufacture their own fertilizers, by using bone-flour, two tons; leached ashes, one ton; plaster, one-half ton; hen-house scrapings, one-half ton, with a few bushels of salt. An application of two hundred pounds is good for twenty bushels of wheat, and the same quantity of bought manures, at nearly double the cost, will do no better. Albemarle: About one-fifth of the cultivated surface is improved. For wheat one hundred

and fifty to two hundred pounds of commercial manure are applied to the acre; for oats, fifty to one hundred pounds; for corn, one hundred to one hundred and fifty pounds, and for tobacco, two hundred to four hundred pounds. The increased production about pays the expense, the chief advantage being in securing a good stand of clover or grass. Farm-pen and stable manures do not receive merited attention. Nelson: Great complaint is made of the adulteration and worthlessness of bought manures, rendering it neither safe nor profitable to purchase any except plaster, ground bones, and some of the tobacco fertilizers prepared at Richmond. Farmers rely mostly on clover, plaster, and stable and barn-yard manures for the improvement of their lands.

Tide-water district, (*Southside.*)—Surry: Commercial manures are used very extensively, and with good results. From one-third to one-half the cultivated area is fertilized, the usual application being one hundred pounds of guano or phosphate, with fifty bushels of lime or one hundred and fifty bushels of marl to the acre. Commercial fertilizers are used to a greater extent than home-made, but the latter produce the best effect in dry seasons like the last two, and the use of them is on the increase. Southampton: Fertilizers are applied to a very limited extent; home-made and commercial about half and half, and the results are similar, increasing the product fully 25 per cent. Isle of Wight: Fertilizers are used to a large extent on peanuts and potatoes, but, as a general rule, on no other crops. Probably one-fourth of the tilled lands is annually fertilized by an application of one hundred and fifty to two hundred pounds of Peruvian guano, and a larger quantity when other concentrated manures are used. Farmers are making a good deal of farm-yard manure from their stock, but the greatest results are believed to be from the commercial fertilizers, particularly from guano combined with plaster. Princess Anne: No artificial fertilizers are used except in the cultivation of Irish potatoes. Barn-yard manure is relied on for corn. No other manure can be found to supply its place, and much attention is being paid to its production. Norfolk: The reports are occupied with details of the truck business, for the prosecution of which it is well known that a vast amount of fertilizing material is necessary. Commercial manures are extensively used, and large quantities of putrescent manures are annually obtained from all the neighboring cities in convenient reach by water.

Piedmont district, (*Southside.*)—Chesterfield: At least one-half of the lands have been fertilized, until it is now almost impossible to raise wheat without guano or some other bought manure. Even then it takes two hundred pounds to the acre to realize as much as ten or twelve bushels. Farmers are generally coming to the conclusion that lime upon clover or pea-fallow is the surest way of improving their poor lands. Home-made manure is preferred for permanent results. Powhatan: Concentrated manures are used to a much less extent than formerly. They are not thought to pay except on the tobacco crop. Not more than one-fourth of the tilled acreage is manured. Home-made manures are used only on tobacco. Cumberland: Fertilizers are applied to considerable extent, about one-fourth of the cultivated land being thus treated: for tobacco, four hundred pounds per acre; for wheat, two hundred pounds. Nearly all of the home-made manure is given to the tobacco crop. On the poorer lands, about half the usual quantity of fertilizers is combined with it. Amelia: Fertilizers are used to a large extent, being applied to about two-fifths of the tilled acreage. Rate of application, about two hundred pounds Peruvian guano, or three hundred pounds manipulated, and eight to ten wagon-loads of farm, pen, or

stable manure. Relative proportions of home-made and commercial about one to ten. Results of the crops about equal, but the land on which the home-made manure is used is more permanently benefited. Lunenburg: Fertilizers are applied to a very limited extent. Not more than one-hundredth of the cultivated land is improved at all, and that improvement is effected both by home-made and commercial manures—800 bushels per acre of the former, or 300 pounds of the latter, by which production is doubled. Distance from transportation prevents the use of lime and other cheap manures. Nottoway: Fertilizers are used to a limited extent, being confined chiefly to tobacco lots, which constitute but a small portion of the tilled surface. Rate of application, two hundred and fifty to four hundred pounds per acre. Not much attention is paid to domestic manures. When applied to the same crop, a liberal coating of domestic manure is equal to about three hundred and fifty pounds of fertilizer in first production, but the former has the advantage in permanence. Appomattox: There are more home-made manures than fertilizers used. They are regarded as more economical, and are attended with better results. Commercial manures are not profitable unless when applied to tobacco, to be followed by wheat. Buckingham: Fertilizers are extensively used on the tobacco crop, but sparingly on other crops. About one-tenth of the tilled acreage is devoted to tobacco. The superphosphates have mostly taken the place of guano. Rate of application, about four hundred pounds to the acre. There is but a small number of stock in the county, and but little farm-yard manure is made; but so far as it goes, the tobacco grown with it is heavier and of richer body. Campbell: Very little commercial manure purchased by farmers; and what little manure of any kind there is used is derived from the stables, cow-pens, and ash-banks. Charlotte: Formerly commercial manures were very largely used, but latterly the results have not been satisfactory. Especially has this been the case with the wheat crop, so that in reference to that they have been almost abandoned. They are still freely applied to tobacco, at the rate of two hundred to five hundred pounds per acre, and as this is universally followed by wheat, the success attending it is better. Home-made and commercial manures are sometimes combined, and this is considered by many farmers the most economical use that can be made of both. Prince Edward: The extent to which fertilizers are applied is limited only by the means of the farmer. About six per cent. of the land in cultivation is usually planted with tobacco, which is all fertilized. The rate of application is about one hundred and fifty pounds per acre, and the product is increased one hundred per cent. Farm-yard manures are looked after only in the old fashion. Pittsylvania: Commercial fertilizers are generally applied to the tobacco crop. Peruvian guano is the most popular, though several superphosphates are being introduced, and applied at the rate of one hundred to two hundred pounds per acre. Franklin: Almost all the lands cultivated with tobacco are fertilized in the same way, and in some instances portions of the corn and wheat crops. Nearly one-half of the cultivated land is fertilized. The increased production cannot be accurately stated, but it is believed to be five-fold in some instances, and sometimes more. Some of the manipulated fertilizers for tobacco are the most profitable. Patrick: Very little use is made of fertilizers. The distance from railroad communication and from market, with the lack of improved implements, renders their use impracticable.

The Valley.—Clarke: Only a small proportion of fertilizers used, and farmers are not at all satisfied with the results. If they are beneficial

at all, it is in giving an early start to the corn. Animal manure from the stables and farm-pens shows improvement for years, and a good degree of care is taken in saving it. Augusta: Few fertilizers are used except barn-yard manure and plaster. The latter, mixed with ashes in the proportion of one-third to two-thirds, and applied in the hill, is very beneficial to corn, and is sown with fine effect on the new crop of clover, in March or April, at the rate of two bushels of plaster per acre. Home-made manures are used in much larger proportion than commercial, and, except in comparison with plaster, with better results. The latter increases the production of corn and clover 25 per cent. over bought manures, and in an equal if not greater ratio over barn-yard manure. The soil is mostly limestone. Rockbridge: Commercial manures are used to a very limited extent, not affording opportunity of stating satisfactory results. The main reliance is on lime, plaster, and clover, with stable and barn-yard manure when at command. Highland: No commercial fertilizers used; nothing but stable manure. Hay is generally stacked and fed on the meadows. From five to twenty loads of manure are as much as is generally made on a farm, and this is mostly applied to garden patches. If any is left over, it goes to the corn-field. Botetourt: The best farmers have almost abandoned the use of bought fertilizers, and are turning more attention to home-made manures, with lime, clover, and plaster, from which the results are more satisfactory. Roanoke: Only a small quantity of commercial fertilizers used. The chief value they promise is in securing a stand of grass; but this is attained as well by the use of plaster, which farmers sow every year on all their grass lands, at the rate of sixty to one hundred pounds per acre. The lands are very easily improved by grass and plaster.

Southwest Virginia.—Montgomery: Bought manures are used to a very limited extent, with the exception of plaster, which is applied quite freely. Not more than one-tenth of the tilled acreage is fertilized in any other mode than by plaster and the culture of clover. Home-made manure is not carefully saved, and is poor in quality, from the absence of comfortable shelter for stock, and the scarcity of labor; but no land responds more freely to its application, and the productive power of the soil is capable of being almost indefinitely increased by judicious manuring. Pulaski: The use of all kinds of fertilizers is very limited. Wythe: Fertilizers used to a moderate extent; guano more than any other kind, for the purpose of getting the land set in grass. Farmers depend on grazing and feeding their stock to keep up the fertility of their lands. Bland: Stable manure and plaster are the only fertilizers in use, the results depending on the quantity applied. Plaster is found most economical, and affords an increased production of one-half the entire yield per acre. Carroll: Fertilizers are not extensively used, grass crops being mostly relied on for improvement. Not more than one-tenth of the tilled acreage is improved in any other manner, and not more than one-twentieth of the fertilizers used is commercial. A few farmers have used plaster and lime on their wheat and grass crops with beneficial results. Little or no guano has ever been used in the county. Grayson: The use of fertilizers is largely on the increase, chiefly home-made, with plaster from the adjoining county of Smythe. Plaster is regarded as the cheapest of all fertilizers. It is applied at the rate of one bushel to the acre, with ten to twenty loads of barn-yard manure, either for corn or wheat—mostly the latter. Plaster alone will increase the product of grass three to four fold. Neither guano nor superphosphates have been used in quantity worthy of mention. Washington: Fertilizers of some description, either from the

stable, the barn-yard, the lime-kiln, or plaster banks, are used by all good farmers. Plaster is the one thing most needed, and with the least expense produces the heaviest crop of grass, and the most abundant crops of corn and other grain. An experience of forty years shows that an application of one bushel to the acre will increase the product of grass four-fold. At Saltville two varieties of fertilizers are manufactured, in one of which plaster, salt, and ashes, in equal proportion, form the component parts; in the other, plaster and ashes in equal parts. They are both highly approved by the farmers who have tried them. Scott: The use of fertilizers is quite limited. About one-fourth of the cultivated surface is manured.

FARM ANIMALS AND IMPROVEMENT OF FARM STOCK.

Tide-water district, (Northside.)—Henrico: Farm animals have largely increased since the war, but the number was very much diminished, and has not yet been brought up to the standard of 1860. Some attention is paid to the improvement of cattle, the Ayrshire and Alderney being the favorites. Much more than ordinary attention is being paid to hogs, the white Chester having the preference. New Kent: A visible increase of farm stock of all kinds. Some improved horses have been introduced, such as the Morgan, Revenue, and Red Eye, with a few fine specimens of Planet. Short-horn, Ayrshire, and Alderney cattle have been introduced, and are making some headway. Chester and Irish Grazier breeds of hogs are preferred, and much attention is paid to the improved breeds of poultry. The farmers are ambitious, and doing all they can to make progress. York and the Peninsula: The response comes, "very slowly." King William: Efforts are being made to improve the stock of all descriptions. Working animals are increasing, though still not so numerous as they were ten years ago. Cattle as usual, though some improved stock has been imported. The stock of hogs is being improved by crosses with the Chester and Berkshire. Essex: Farm animals are not increasing in numbers. A few farmers are struggling to keep up the stock of improved breeds they had before the war, and now and then one is endeavoring to raise a fine horse. The breeds of cattle preferred are the Devon and Ayrshire; of hogs, the Chester and Berkshire; and of sheep, the Southdown. King and Queen: Farm animals increasing, but no particular care or thought is given to improved breeds. Many of the mares are the broken-down animals left by the war, and are utterly worthless except to breed mules. King George: Farm animals are not increasing, except such as are used in cultivation. The destruction by dogs prevents the increase of sheep, and has prevented some farmers from raising them. The Cotswold is regarded with most favor, the Merino with the least. There are some good cattle; the Devons are thought to be best suited to the climate; and there are some good crosses of Devons and Short-horns. The county is well suited to the raising of good stock, and sheep would do well if the dogs were out of the way. Richmond: The improvement of farm stock is engaging greatly increased attention. The breeds preferred are Cotswold sheep, Jersey and Alderney cattle, and Chester hogs. Northumberland: Stock of animals generally quite small. A few of the Devon cattle, Cotswold sheep, and Chester and Cheshire hogs have been introduced, and promise well. Lancaster: The best breeds of horses and Spanish jacks have been introduced; also Chester, Jersey Red, and Essex hogs. Cattle are improving, and the increased sales show the profit of hay and pasturage afforded by the system of rotation.

Piedmont district, (Northside.)—Stafford: There is improvement in farm animals, to a small extent in horses and hogs. Prince William: Stock slowly increasing, though but little attention is given to improvement of breeds, except in a few instances. The climate is well adapted to stock-growing, and northern men are disposed to engage in it. There is only one large stock-grower in the county; he sold $14,000 worth of neat cattle last year. Alexandria: Not being a stock-raising region, the increase of farm animals is limited, confined chiefly to milch kine and swine, with poultry. Of cattle, the partiality is for the Alderney and Devon; of swine, the Chester; and of poultry, Brahma. Fairfax: Cattle and horses are improving, but not much attention is paid to breeds. Caroline: Farm animals are increasing. Short-horn cattle are preferred. Chester hogs are rapidly increasing, and promise the most remunerative results. Cotswold sheep are held in most esteem. Horses and mules are in about equal number; the latter are regarded as best for farm work. Louisa: Formerly much attention was paid to stock, and improved breeds were introduced to considerable extent. Short-horns and Devons were looked on as the best strains for cattle, and Cotswolds for sheep. Traces of these yet remain; but, on the whole, farm stock has decreased. Loudoun: Farm animals are greatly on the increase, mostly horses and cattle; of the former, the heavy draught, (much used in the country;) of the latter, the Short-horn. Less attention is given to hogs and sheep. Fauquier: This county being peculiarly adapted to grass, stock is usually kept in large numbers, say from 35,000 to 40,000 head of cattle, and untold numbers of sheep and hogs. The hogs follow the cattle in winter when feeding on corn, the most of which, except breeders and pigs, are sold off in spring, when the cattle are put on grass. The Chester and Essex are the favorite breeds of hogs; the Southdown and Cotswold of sheep; and the Short-horn for cattle, particularly the red Short-horn, of Alexander's Kentucky breed. Farmers are turning their attention particularly to raising their own cattle, and in fact all stock. Of the 40,000 head of cattle in the county, about two-fifths are home-raised, and about three-fifths imported from Southwest Virginia, Tennessee, and North Carolina, and West Virginia. Madison: The farm animals were largely destroyed by the war, and, owing to the impoverished condition of the farmers, efforts to replace their exhausted stock have thus far been crippled. Attention to the improvement of breeds of horses, cattle, sheep, and hogs, is confined to a very few men of means. Greene: The number of farm animals is not more than one-half as large as before the war; but for the last three or four years there has been an increase in cattle. Very few sheep. Stock of no particular breeds; all of the ordinary native kinds. Culpeper: Farm animals are generally on the increase. Considerable attention is given to farm stock as a more reliable source of profit than wheat. A few improved Short-horn and Devon cattle are being brought into the county. As the lands are well adapted to the grasses, stock-raising receives more attention. Albemarle: Horses of different breeds, both blooded and draught, are increasing; also cattle, principally Short-horn, with some few Devons. The Chester, Surry, Berkshire, and Woburn breeds of hogs have been introduced. Nelson: A decided interest is manifested in the improvement of cattle by the introduction of the Devon and Short-horn stock. There is some increase in hogs, but little or none in horses. The Chester and Berkshire hogs and their cross are engaging the attention of farmers to a limited extent.

The Valley.—Clarke: Farm animals of all kinds are increasing, but it is only their natural increase. None of the improved breeds have been

brought into the county, with the exception of a few Chester hogs, and one or two Short-horn bulls. Augusta: In one portion of the county farm animals are increasing considerably, and stock of all kinds—thorough-bred horses, Short-horn cattle, and Chester hogs—is receiving more attention. In other portions the improvement is less perceptible. Rockbridge: A very marked improvement is manifest in farm animals—horses, cattle, and hogs. In these particulars, perhaps, no county in the State has made so great an advance in the last five years. The improvement in horses has had reference to general utility, the object being to secure such as are suitable for heavy draught, light draught, and the saddle. Short-horn and Devon cattle are preferred, and Chester and Essex hogs. Highland: Domestic stock can hardly be said to be increasing or diminishing, the object being to keep only a sufficient number for use, and to sell off all surplus. During the past year about 3,000 fat cattle, 120 horses, and 2,000 sheep were driven from the county. Considerable attention is given to the improvement of every kind of stock. These remarks will apply in substance to Bath and Alleghany, the three counties being situated between Rich Mountain and the Alleghanies, and forming rather a subdivision of the valley than a part of the valley proper. Botetourt: Farm animals are rapidly increasing, with great improvement in cattle. All farmers find it to their interest to get off their scrub cattle, and replace them with Short-horns, particularly since the decline in produce and advance in beef. Roanoke: The increase of farm animals is very great, with the exception of hogs. There is an increasing desire for improved stock, particularly cattle and horses, the Short-horn being the favorite breed of the former. Sheep have been neglected, but are now receiving more attention.

Southwest Virginia.—Montgomery: Stock has been steadily increasing since the close of the war. The most particular attention has been directed to cattle, and of all the breeds the Short-horn and higher grades of the same are in most favor. But little attention is paid to sheep husbandry, though much of the rich mountain land is admirably adapted to it. Chester hogs have been introduced to some extent, but the hog stock of the county consists principally of the native breed, based originally on the Berkshire and Irish Grazier. Quite an activity in raising horses prevails, which are, with few exceptions, inferior stock. Pulaski: Horses, cattle, and hogs are gradually increasing from the stock on hand previous to the war. None of the improved breeds have been introduced. Wythe: Farm animals are increasing to a moderate extent. More attention is paid to cattle than any other kind; the Short-horns preferred. Cotswold sheep and Berkshire hogs are the favorites in their line, and much attention is paid to their improvement. Bland: Farm animals are on the increase. Cattle engage much attention, and the herds are composed of numerous varieties. Carroll: This being a grazing county, particular attention is paid to the improvement of cattle, experience demonstrating the advantages of improved stock. Much attention is paid to raising mules and horses, which is becoming a very common and profitable occupation. Hogs are also raised to considerable extent. Grayson: The raising of stock constitutes the main business of farming in this county, horses and cattle receiving most attention. The horses are of a hardy, serviceable stock, of which the farmers have always been rather proud. Cattle, both in number and quality, (having been improved by the Short-horn,) are far in excess of what they were five years ago, and from their profits the business of the county is carried on. Washington: Cattle are on the increase, particularly of improved stock, of which the Short-horns are preferred. Hogs

not so numerous as they were ten years ago, which is attributable to the cholera. The Chester is the favorite. Horses and mules have neither increased in numbers nor improved in quality. Sheep not extensively raised, owing to the partiality people have for dogs. Scott: Improvement of farm stock is engaging attention, but only to a limited extent.

CONCLUDING REMARKS.

With all the industry we have used, there remains a number of important counties in the State—several in each geographical division—from which we have failed to get returns. On the north side of James River the tide-water and Piedmont districts are very fairly represented by the counties enumerated. It would be gratifying, however, to have had reports from Goochland, Fluvanna, and Amherst, on the Upper James, in which the system of farming was formerly as perfect as in any part of the State, and also from Hanover, Spottsylvania, and Rappahannock. Hanover, however, in respect to the lower portion, may be classified at the present time with the best counties on tide-water; Rappahannock with the neighboring counties of Fauquier and Culpeper; and Amherst with Nelson. On the Southside the omissions are not less to be regretted. Greenville, Brunswick, Mecklenburg, and Halifax were formerly distinguished for their productiveness, chiefly in the article of tobacco, and largely, also, in wheat. Halifax was the largest tobacco-producing county in the State. Bedford, while long famed for both tobacco and wheat, is a fine grass country, where grazing is, or was, profitably followed. With the exception of the small county of Clarke, we miss altogether the lower half of the Valley, embracing Frederick, Shenandoah, Warren, Page, and Rockingham. These constitute a very important part of the State; but as the farmers have always been noted for their industry and thrift, and as it is divided, to a large extent, into farms of moderate size, we may conclude that it is recovering its prosperity in at least an equal ratio with Augusta, Rockingham, and Botetourt. In Southwest Virginia there is no important omission, with the exception of Smythe. It is in this county that the celebrated plaster beds are found, which furnish an abundant supply of this mineral to all the adjacent country, as far as it will bear transportation. Its use, as the reader has been informed, produces wonderful results. The condition of agriculture in this county is very much the same as in Washington and Wythe. In Russell the same features prevail, but in Buchanan and Wise, at the base of the Cumberland Mountains, they are very distinct. They are outside the grass region, and agriculture is at a very low ebb.

From the Eastern Shore, composed of the counties of Accomac and Northampton, no returns have been received. It may be remarked, however, that the farm crops consist almost entirely of corn and oats, under a three-years' course. The third year the land puts up the Magothy Bay bean, (*Cassia chamæcrista*,) which, though indigenous to other parts of the State, grows most luxuriantly in a saline atmosphere. It furnishes an abundant crop of green manure, by means of which the fertility of the land is indefinitely maintained. The principal market crop is oats, which is extensively used in the interior of the State for seed and other purposes. Much attention has been paid, of late years, to trucking. Sweet potatoes, Irish potatoes, cabbages, and fruits are raised in large quantities.

Taken as a whole, the picture presented, though not so flattering as could be wished, offers many attractive features. We have taken a very close view of the inner life of these old Virginia farmers, and

find much to approve. It should be borne in mind that only five years have elapsed since the agriculture of the State was utterly prostrated. The people waked up as out of a dream, to see their labor system overthrown, and their lands lying idle. Nearly all kinds of farm stock had been swept off by the hurricane which passed over the country, and but few agricultural implements remained. It was not to be supposed that the former servants, suddenly enfranchised after two hundred years of bondage, would be otherwise than unsettled by the change: but large numbers gradually returned to steady habits, quite as steady, perhaps, as could have been anticipated by the most hopeful. They still constitute the great bulk of the labor of the State; and valuable labor it is, in spite of many irregularities. The Virginia farmer, at least in Eastern Virginia, could not get along without it. With kind treatment and payment according to contract, the negro is as tractable as ever; and in time the interests of the two races, instead of appearing diverse, will become one.

A striking mark of progress is the change in the policy of the planters toward the outside world. Formerly they were indisposed to encourage immigration from other States. There was, therefore, no accession to the population of the rural districts from abroad. The same traditions and habits descended from father to son through successive generations. Now all this is altered. Strangers from every State and every country are cordially welcomed whenever they show any disposition to become permanent settlers and industrious citizens. The consequence is, that in many counties a strong tide of immigration is setting in, bearing with it improved stock and better implements, which cannot fail to impart a healthy impulse to improvement.

Upon the whole, we regard the signs of the times as evidently auspicious of future progress. From a state of desolation and almost despair, in 1865, the agricultural productions of the State have steadily increased in amount and value until, in 1870, we find the tobacco crop one of the largest grown in the State for many years; that of cotton greatly increased; the Richmond mills supplied to their full capacity with wheat; and the crop of corn plentiful in proportion. Improved methods of farming are being gradually adopted; more attention is paid to the accumulation of manures; the area of cultivation is being reduced; and high culture is taking the place of the old. This is the direction to which agriculture is tending in many parts of the State; by degrees we may expect it to extend over the whole; and it may be confidently predicted that the man who survives to see the Virginia of fifty years hence will not be able to recognize in its features the Virginia of 1870.

GREEN CORN-FODDER FOR MILCH COWS.

The practice of sowing corn broadcast, or planting it in drills, to be cut daily and fed in a green or slightly dried state to milch cows, in August or later months, mainly to supplement the supply of grass in the driest portion of the season and equalize the consumption of milk-making material, is almost universal among enterprising and intelligent dairymen. In supplies for farm animals, our abundance, which actually runs to waste, is not distributed through the year; the prodigality of the flush spring-time, the season of rain and verdure and succulence, is followed, in midsummer, by drought and a stinted measure of tough.

harsh stems of dried grasses. Unless the early growth is left half depastured, the feed of August will be inconveniently short; and should it be thus left, its quality will deteriorate, and the future pasturage be less valuable; thus extra feeding, in the later months of summer, is found to be a necessity that no dairyman can ignore with immunity to pail or purse.

Then what shall be fed? That which yields most milk and flesh at lowest cost. Unfortunately, discriminating and decisive experiments have not been made by which the matter may be set permanently at rest. Were the most careful experiments made in different climates and circumstances, upon different soils, and in several seasons, the result would still show the greatest diversity of opinion. A plant that grows well upon one soil may fail upon another that is unsuited to it, even under the same culture. But we find, as an existing fact, that the leaves and tender stalks of Indian corn, (*Zea mais*,) cut in different stages of its growth, are the almost universal resource of dairymen in all parts of the country for tiding over the season of drought and scarcity.

If the average practical sense of the masses claims the paternity of a practice which becomes almost universal, the value of green corn-fodder can only be disproved by positive testimony. The fact that maize is an indigenous product, peculiarly suited to our climate, thriving in every portion of our country, except in Alaska and on the mountain tops, and the most valuable tilled crop that has ever been grown on the continent, is strong presumptive proof that its fodder, if worth anything for soiling, may exceed in value, in view of the certainty of its growth and quantity of its production, that of some if not all other fodder plants. Strong as is this presumptive claim, the superiority of corn-fodder cannot be thus assumed. If experiment, full and varied, shall establish the superior excellence of some exotic or native plant, let the practice of our farmers be reformed, and a better material for soiling milch cows be employed.

There has been considerable discussion of late at farmers' clubs, in the fields, and at firesides, concerning the value of this fodder. More than this: it has been denounced as worthless, as costing more than its real value, or as the poorest feeding material in use. The charge that it is worthless is untenable and reckless, and cannot be considered. The question of its comparative value is one that should be examined carefully, and, if possible, settled.

We have sought from practical agriculturists and working dairymen in different parts of the country views based upon their own experience, and supported by facts and experiment. The communications received have been interesting, though desultory in statement, and many of them inconclusive in results; yet they all agree that there is value in this material, and a large majority accord to it a high estimate, very few of whom venture to name a substitute of equal merit.

Mr. Sanford Howard, secretary of the Michigan State Board of Agriculture, (since deceased,) wrote to the Commissioner of Agriculture upon the question, in December last, as follows:

The controversy to which you allude seems to have taken its rise from a public statement of Dr. George B. Loring, of Salem, Massachusetts, to the effect that green corn-fodder was the poorest food for milch cows that he ever used. The expression was unmercifully pounced on by correspondents of various agricultural papers. But it seemed to me that the dispute was not unlike that we read of in regard to the red and white shield; that both parties might to some extent be right and to some extent wrong.

While I lived with my father, and for some years subsequently, I fed considerable corn-fodder to milch cows. I noticed that when it was grown very thickly on the ground,

and especially when it was cut in an immature state—before it blossomed—the stock did not like it so well, and it did not seem to do them as much good as when it had more space during its growth, and was allowed to stand till the ears commenced forming.

I think Dr. Loring did not state how his corn-fodder was grown; but recollecting that I had seen it growing on his farm in very close hills, I wrote an article designed to show that the nutriment contained in this fodder depended much as to whether it was, while growing, so much exposed to the light and air that the juices of the plant would be properly elaborated. Since that I have heard from other persons who have had more or less experience with "fodder-corn."

Mr. Gibson, the superintendent of the farm of Messrs. Walcott and Campbell, New York Mills, New York, stated to me, while on a visit to the farm a short time ago, that he tried various things as green food for the stock kept in the stables and yards, giving the preference to *lucern*. He made an assertion in regard to corn-fodder similar to that attributed to Dr. Loring.

I will mention one *fact*, which of course you will take for whatever you think it worth, in regard to sweet corn-fodder as compared with the fodder of other varieties of corn. I have known several instances where cattle, having been kept on the fodder of sweet corn until the crop was all eaten, refused for some time to eat the fodder of *dent* corn in the same stage of growth, and grown in the same way. They would eat the fodder of *flint* corn better than they would that of the dent, but did not like either as well as they did sweet corn.

Fodder-corn has been grown and used to some extent on our college farm, but no attempt has been made to experiment with it.

Of those whose opinions adverse to the use of green corn have been quoted, Dr. Nichols, of the Boston Journal of Chemistry, considers green corn-fodder a "kind of food for animals not profitable to raise;" and makes the following statement of his reasons for the opinion:

It is not so because the maize plant is not rich and succulent, but because the conditions under which it is grown are unfavorable to its perfect and healthy development. The natural juices of the plant are richly saccharine at maturity, when grown in hills in open space, with plenty of air and light; but grown in mass, in close contiguity, this principle is almost wholly wanting. To test its comparative value with the green stalks taken from the corn-field, I fed to my herd of cows in August a weighed quantity of the corn-fodder, so called, night and morning, for one week; they were then changed to the field corn-stalks, and the gain in the milk product at the end of the week was a little more than 8 per cent., and there was also a manifest improvement in quality. As a rule, all vegetable productions grown under conditions where the chlorophyl, the green coloring principle of plants, cannot be produced in all its richness of tint, are abnormal, immature, worthless. The absence of this principle in the whole of the lower portion of the corn-plant grown in drills, or from broadcast sowing, indicates its watery, half-developed character.

While entertaining a very poor opinion of the immature and colorless corn, the editor of the Journal of Chemistry apparently yields to none in his estimate of the value of mature and dry corn-fodder, including both the blades and butts, as appears from the following:

The fodder is a very important item connected with corn-raising. We always remove the top stalks in a green state and allow the corn to ripen in the open field. The "butts" or lower stalks after husking are taken good care of, as we depend largely upon them to keep up the flow of milk in our herd of cows during the winter. They are pitched over, a moderate quantity of salt is diffused through them, and then they are mowed with alternating layers of wheat straw. Their value, when carefully preserved is but little less than that of good upland hay, estimating ton for ton. There is much saccharine and nitrogenous material in the "butts," and animals will eat them if they are kept sweet and clean and properly fed. Out of four tons fed to one herd the past winter, not five hundred pounds have been rejected, and we have neither chopped nor steamed the fodder. To raise corn, we must plow in the autumn, and spread on the manure green from the cellar in the spring. We must harrow it in well, and have the soil well pulverized. In the hills, place a handful of the mixture of bone and ashes so often alluded to; this mixture must *not* be thrown in all in a mass, and the seed dropped directly upon it; let it be thrown around the hill and a little soil scattered over it, and upon this place the seed. Select a field which is neither very wet nor dry, and with this treatment every farmer can raise corn profitably.

OPINIONS OF LEADING FARMERS.

Hon. Horatio Seymour, of Utica, New York, president of the Ameri-

can Dairymen's Association, communicates the unequivocal indorsement by that body of the value of green corn-fodder as a supplementary food for milch cows, after a full discussion at the annual convention at Utica, in January, 1871, and presents in detail his own views, which are in harmony with the decision of the meeting:

The farmers of Central New York are almost exclusively engaged in making butter or cheese. This is carried on with so much skill that most of the cheese made here is sent to England, and this article of food has become one of the leading agricultural exports from this country. A convention is held in this city in the month of January of each year, which is made up of delegates from most of the Northern States, and some from the Southern States and from Canada. It meets to discuss questions relating to the interests of dairymen, in all their aspects. The proper treatment and the best food for cows are prominent topics. As this body of six or seven hundred practical, skillful, and leading farmers represents the judgment of those engaged in dairying in a great section of our Union, I deemed it my duty to lay your letter before it. After a full discussion, it was declared by a formal resolution "that green fodder is a valuable crop, and that its use as a summer feed for cows is recommended to the farmers of our country." I look upon this judgment of the American Dairymen's Association as conclusive upon this question. It gives the sum and result of the largest, longest, and most varied experience. It is the result of the greatest number of practical trials by practical men, who are not trying to prove theories, but who are striving to support themselves and their families by making their farms profitable. There was a difference of opinion as to the best ways of sowing and gathering, and also with regard to the kinds of corn which should be used. It is a proof of the value of the crop that it is found to be useful whatever plan is followed in raising it. In this section of New York I think the farmers usually sow the large western corn. The seed is kept for the purpose at our seed-stores, and care is taken to get that which is in good condition. The seller usually gives proof of this by putting a given number of kernels in a pot of earth, and the buyer can see what proportion has sprouted. Some sow broadcast, while others plant in drills. On my farm it is put in broadcast, on well-prepared ground. Three bushels of seed are used on an acre. The same ground is used for a series of years. This is done because it is thought it takes less manure to keep up the needed fertility than it does to prepare new ground. It also enables one to put the crop on land which is conveniently situated. The dense growth of the corn keeps it clear from weeds, and leaves the ground ready for a new crop. I think when the seed is sown broadcast the stalks stand closer and grow more slender than they do when the corn is drilled in. It gains in nutritive qualities until autumn. To save it from early frosts it is sometimes cut down with a scythe or a corn-cutter, and suffered to lie upon the ground until it is used up. It is not injured by rains or the sun, where it is not exposed more than a week or ten days. In some instances it has been kept in the fields, put up in small stacks, until the winter months, but it is difficult to cure it except in small quantities, when it can be thrown upon hay-mows, in the barn. With us it is most useful when fed to cows in August and September, as at that time our pastures are usually short. If cows are then put into a convenient field and fed with corn-fodder, there are many advantages gained. A change of food after the heat and exhaustion of summer is grateful to them. It gives new vigor. In the mean time the pastures are usually renewed by cooler nights and more moisture, and if they are allowed to gain a flush of feed when the cattle are turned back upon them, they have another and healthful change of food. By this system the hurtful practice of pasturing meadows in the autumn is avoided.

The question naturally comes up, why there is a difference of opinion about the value of this crop. I think it is owing to the fact that with some it is not the best crop they can raise as they are situated, and therefore they condemn it. The question is not if it is the best crop for summer feed at all places and under all circumstances, but is it a valuable crop? Like all other things, it must be used under favorable circumstances. In one place it may be the most profitable and in others the least profitable forage for cattle. The same thing is true of root crops, of lucern, of clover, &c.; climate, soil, and price of labor must always be taken into account. In the dairy region, where cows are milked in summer and autumn, sowed corn can be used at the time when fodder is most wanted; that is, when pastures are usually dry. It does not call for extra farm labor to plant or to gather.

Mr. Joseph Harris, of the "Agriculturist" paper and "Moreton Farm," Rochester, New York, in an address before the American Dairymen's Association, at Utica, in January, 1871, held that it makes comparatively little difference what food is used, provided it is easily digestible and contains the requisite amount of nutriment in the desired bulk, and thinks the difference of opinion in regard to the value of corn-fodder

will turn upon this point. He said further: "Corn-fodder is succulent, easily digested, sweet, and nutritious; but, at least before it has commenced to ear, its nutriment is not sufficiently concentrated. If we could take away one-third of the water and one-third of the indigestible woody fiber, the part that remained would be of much greater value than the whole. The water we can easily get rid of, and if we cannot get rid of the excessive bulk, we can feed out sufficient corn-meal with the fodder to bring it up to the desired standard."

Mr. E. W. Stewart, of New York, deems the profitable use of green corn as a summer food for milch cows a settled fact, if any questions in practical agriculture can be considered settled. He states that hundreds of instances may be cited where green corn has produced the highest yield of butter.

Mr. Frank D. Curtis, of Charlton, Saratoga County, New York, regards green corn-fodder excellent material for soiling, and for use in autumn in a partially dried state, when it is "very nutritious and almost invaluable" for young animals of the farm. He recommends planting in drills in cultivating.

Mr. W. L. Locke, jr., of Irasburg, Vermont, last August fed corn-fodder to his cows, and increased thereby the daily quantity of milk from forty-five to fifty-one pans, or 13 per cent., and the cream had a better color.

The editor of the Maine Farmer reports a case in which the pasture was dry and short, and corn-fodder fed almost exclusively. The flow of milk was increased at once, and made a fair average for the season, notwithstanding the unusual proportion of fodder given, while neighbors' cows not thus fed shrunk one-half in quantity during the dry season.

Mr. Robert Gibson, farm manager of Wolcott & Campbell, of New York Mills, Oneida County, New York, in a letter to Mr. Sanford Howard, expresses a preference for lucern over corn-fodder, as follows:

Although I agree with you in regard to corn-fodder, I go a little farther, and say that when it is *grown very thick* and fed early—that is, before it is in full tassel—it is the poorest green feed I ever used. In its very best stage it is not so good as lucern; that has been my experience. I have no object in speaking so highly of lucern except that of inducing persons who wish to soil stock to give it a trial. It can be cut four or five times a year. This season I cut it five times. By giving a coat of manure in the fall, it will keep in the ground four or five years, consequently saving the expense of plowing, seeding, &c., every year.

The editor of Hearth and Home has found that drill-sown or broadcast corn is uniformly eaten with avidity, and that it as uniformly insures a large and full flow of milk.

Mr. William Ramsdell, of Milford, New Hampshire, attests the prevalent practice among dairymen in his vicinity of feeding green corn-fodder during August and September, in the full belief that it increases the flow of milk and improves the condition of the animals. He makes the following statement of the result of an experiment with millet:

Some two years ago Dr. Loring asserted in his public address that corn-fodder was of no value in producing milk, and advised the raising of millet as a substitute, which would not only increase the flow of milk, but could be raised at much less expense. In accordance with this suggestion I, with some of my neighbors, last year and this have tested the experiment to our satisfaction, and shall return to the raising of fodder-corn. But I would say that much of the value of fodder-corn depends upon the time at which it is cut. My experience has led me to raise fodder-corn as follows: I sow in drills (in preference to broadcast) early in the month of May for my first cutting, dropping the seed from three to four inches apart, and commence cutting in August, or when the corn begins to tassel. If cut before this stage it has much less nutriment. I disapprove of the practice of topping when half grown, with the expectation of a second crop. I sow at intervals of two weeks, to the month of July, and hoe until the corn completely shades the ground; and if I have a surplus I cut and dry it before the season of frost. I approve of cutting the day before consigning it to the barn, in order

to have it wilt. I cut close to the ground, and my cattle leave no orts. In this way I am enabled to retain my usual quantity of milk, and, I think, improve the condition of my herd, when my feed in the pasture is rapidly decreasing, and I know of no other way in which the same results can be obtained at the same cost.

Mr. Levi Bartlett, of Warner, New Hampshire, thinks there is small nutritive value in very late, thickly planted, and therefore colorless and immature corn-fodder. He recommends sweet corn for soiling purposes, fed when the ears are fairly formed.

Mr. Nathaniel Dwight, of Belchertown, Massachusetts, says the practice of feeding green corn is deemed remunerative in his section. It is sown broadcast.

Mr. C. H. Wolford, of Corry, Pennsylvania, thinks green corn fed to milch cows will pay only in places where grass is liable to dry up, when the green fodder will prove a good substitute. He thinks that when corn is fed to cows it injures the quality of the milk; and says they will not keep up the flow of milk after the corn is fed out, and they will not gather the grass they would if they had not had the fodder.*

Mr. John Satterthwait, of Bordentown, New Jersey, has a dairy of twenty-four cows, and sells his milk. He sows corn in drills two and one-half feet apart, eight to twelve stalks to the foot, about the middle of May, and every two weeks thereafter, as long as there remains a probability of its coming to maturity; feeds it "when in the milk state." He states, as his experience last year, that he began to feed it July 15, when it was about four feet high, and when the cows had began to shrink six to ten quarts per day. As soon as he began to feed the green corn they gained twenty quarts per day, and continued the same flow of milk all summer. They were fed through the summer twice a day, night and morning, after milking, and always fresh cut. They did not eat wilted fodder so eagerly. Three acres of green corn were fed out before the last of September, when they fell from one hundred and twenty quarts per day to eighty quarts. Some of the cows were fresh and others nearly dry. He considered the three acres of corn equivalent to twelve acres of good clover pasture. There was no perceptible gain in flesh until the corn began to ear, when the increase was very noticeable. The cows continued in fine order all summer, notwithstanding the dry weather and scarcity of succulent pasture.

Mr. Anson Bartlett, of North Madison, Ohio, a dairyman of long experience, and a cheese manufacturer well known throughout the country, shows how he obtained $50 for an acre of corn-fodder, in increased quantities of butter and cheese, when the former was worth but 12½ cents and the latter 5½ cents per pound:

In the summer of 1852 I tried my first experiment with green corn-fodder for milch cows. I put in just an acre; marked off the rows two feet apart, and planted the corn in hills ten inches apart in the rows, putting from ten to fifteen kernels in a hill. It was cultivated by running a common shovel-plow once between the rows; it made a heavy growth, (being on strong, rich land,) so heavy, indeed, that much of it fell down before it was cut.

At that time I was milking thirty-three cows; a neighbor, whose farm was adjoining, (the two being very much alike in all respects,) also had thirty-three, and up to the 1st of August the product of the two dairies had been very nearly equal; in fact, his was a trifle ahead, but at that time feed in the pastures began to fail, and the cows, of course, gave a diminished quantity of milk. I then commenced cutting and feeding my corn-fodder, what few small ears there were on it being just full in the milk.

My neighbor before mentioned had no corn-fodder to cut, and, of course, his cows had no feed except what they obtained in their ordinary pasture range. I used my

* If cows fail to gather grass as well, it is an indication that they prefer corn-fodder; and if they give less milk, it attests the milk-producing capability of corn-fodder.—[Ed. Rep.]

corn-fodder so as to last just one month, at the end of which time we compared accounts of butter and cheese produced, and the product of my dairy during that month exceeded his during the same time to the value of $50, with cheese at 5½ cents per pound and butter at 12½. My cows were in better flesh than his and continued to give an increased amount of milk some days after the corn-fodder was gone. The experiment, crude as it was, of course satisfied me that green corn-fodder paid well to feed to milch cows, and I rarely failed after that, so long as I managed a dairy, to have two to four acres of corn-fodder.

I tried various methods of growing, as sowing broadcast, three bushels to the acre, and finally decided that two bushels per acre, sown in drills twenty inches to two feet apart, and cultivated by running a shovel-plow through between the rows when the corn was about six inches high, and again when it was from eighteen inches to two feet high, produced more and better fodder than any other method of cultivation tried by me; and this method, with me, always produced about double the fodder to the acre that broadcast sowing would do. The age at which it was cut was not considered very material; we generally began to feed as soon as the corn was full-grown, sometimes before, and continued to feed until frost. Of one thing I became convinced from repeated experiments, which was, that the best way to feed, unless a full feed is given, that is, all the cows can or will eat, is to feed at night, and I finally adopted this method. I had my corn-fodder cut and loaded on a wagon, before the cows were stabled, for the night's milking; then, while they were being milked, the fodder was scattered in the pasture, and as soon as the night's milking was done the cows were allowed to go and eat their fodder, after which they would lie down and ruminate until morning. After the morning's milking, not being accustomed to receive any fodder, they would range the pastures as usual. By a division of the same amount of fodder, giving one-half at night and the other in the morning, the cows would be discontented, seeking mischief during the night, and during the day would be waiting and watching for more, and would not range the pasture as usual for what they might find there; so that while one full feed a day was a decided advantage, two half-feeds were of no benefit, but rather a detriment. When feed in the pasture is very short, by reason of a drought, two full feeds are necessary, but when it is only intended to piece out the pasture, one full feed a day, given after the night's milking, is the proper method.

Mr. Joseph Pelton, of Lansing, Michigan, who has had forty years' experience in feeding corn, deems its value highest for feeding between tasseling and earing, and refers to the marked difference in its juice at different stages of its growth, it having a sourish, bitter taste before tasseling, and a very sweet and pleasant flavor after that period. He claims to have grown, in 1859, near Nashville, Tennessee, upon a single acre, 84,000 pounds of green corn, which made seven tons of cured fodder, by planting two kernels in a place twelve inches apart each way. It was cut when the ears were set and the kernels forming. He considers oats, fed as the head appears, the best soiling material with which he has experimented.

Mr. J. M. Case, of Cold Spring, Wisconsin, thinks evergreen corn, planted in drills, "one of the best crops for soiling."

Mr. C. W. Wilder, of Evansville, Wisconsin, says that fifty farmers contribute milk to his factory, that most of them feed green corn, and those who do feed it bring more milk than those who do not. Evergreen sweet corn, planted three feet apart each way, with five to seven stalks to the hill, is preferred.

Mr. B. A. Griffin, of Dubuque, Iowa, deems green corn-fodder the cheapest and best material for cattle food, after the 25th of June. He also regards it as the best fodder for winter use, cut before frost and put up in small stacks in the field.

Mr. William Richards, of Momence, Illinois, who milks about one hundred cows, drills about twenty-five acres of corn for soiling, feeding green as much of it as the character of the season may render necessary. He finds that it increases the flow of milk about one-tenth. He feeds by scattering on the grass in pasture, not commencing before the tasseling of the corn, and sometimes not till autumn. In 1870 he found it desirable to feed earlier. He prefers to sow in drills, a practice which saves

two-thirds of the seed and admits of cultivation. In this way, he believes he obtains more nutriment from each acre than in any two acres of his best timothy.

ACTION OF THE AMERICAN DAIRYMEN'S ASSOCIATION.

Mr. Harris Lewis, of Herkimer, New York, in an address before the last meeting of the American Dairymen's Association, opposed the practice of feeding corn-fodder, preferring for soiling, first, lucern, if a piece of land suitable to its growth can be obtained; second, orchard grass; and third, common meadow grass. He expressed an opinion that corn costs more, in most cases, than its actual value.

Dr. Wright, of Oneida, said his experience had been just the reverse of Mr. Lewis's. With the ground well prepared and the corn properly sown—broadcast or in drills—and cut when succulent, he had found that all the cattle would relish it, and that it will keep them up to their full flow of milk. He had found small clover good for soiling, in connection with pasturage. The only objection that he found to corn was that its use imparted an undesirable flavor to the milk.

The President, Hon. Horatio Seymour, continued the discussion, favoring the use of corn-fodder, and presenting views similar to those in his communication to this Department.

Mr. Harrington, of Canada, and Mr. Nicholas, of New Jersey, spoke in favor of the economy and profit of feeding sowed corn to dairy cows.

Mr. L. Schermerhorn, of Oneida, had found soiling with corn profitable. He had fed the corn to the cows in a small lot, and this so enriched the soil of that lot that he plowed it and sowed it to corn the next year without more manure, and raised a large crop. He knew of nothing with which we could succeed better than with sowed corn.

Mr. Chapman, of Madison, said that thirty years ago he sowed his first crop of corn for soiling. He was much pleased with it, and had continued its cultivation until the present time. He had raised four or five consecutive crops on the same piece of ground without manuring. If it is not allowed to ear, it does not exhaust the soil much, and corn sowed for soiling should never be allowed to ear. He had made practical and definite experiments in feeding this crop, and had found that when he quit feeding it his cows not only shrunk in their mess, but that a given quantity of the milk made less cheese.

Mr. Dick, of Erie, had found that he could produce more milk from his cows from sowed oats than from corn; but the milk produced by feeding corn was richer, and yielded more cheese, than a like quantity of milk produced by feeding oats or clover.

Mr. Pratt, of Clinton, had practiced sowing corn for soiling, and was satisfied it was profitable. He had never sowed his corn on the same ground two years in succession. He manured the ground specially for the crop. When it was taken off, it left the ground clear of weeds, and he was in the habit of sowing on it the next year wheat or barley, and seeding it down. He knew of two dairymen in his vicinity, having the same number of cows, whose bills of delivery on August 1, showed a difference of 3,500 pounds. One of them fed his cows on sowed corn after that period, and the other did not. The former, whose bill was the smaller, on August 1, gained the 3,500 pounds, and 500 more before September 19. He considers the experiment a practical and definite one.

On motion of Mr. L. B. Arnold, of Tompkins, the following resolution was adopted almost unanimously:

Resolved, That this convention is of the opinion that corn is a valuable product for the dairy farm, and that we commend it as a forage crop.

On motion of Hon. George Geddes, of Onondaga, a committee was appointed, consisting of Messrs. L. B. Arnold, of Tompkins; Harris Lewis, of Herkimer; T. D. Curtis, of Oneida; L. L. Wight, of Oneida; and X. A. Willard, of Herkimer, to consider the following propositions:

First.—The advisability of cultivating corn as a soiling crop.
Second.—The best manner of cultivation.
Third.—At what time in its growth it should be fed.

RESULTS OF CHEMICAL ANALYSIS.

If the analyses of chemists, in the form in which they are reported, are of any utility in determining the feeding value of plants used as forage, the following, taken from tabular statements collected by Emil Wolff, doctor of analytical and agricultural chemistry at the agricultural academy of Hohenheim, may be of use in a comparison of corn with other soiling plants:

	Percentage of—									
	Water.	Organic matter.	Ashes.	Nutriment containing nitrogen.	Nutriment not containing nitrogen.	Woody fiber.	Total nutriment.	Fat.	Phosphoric acid.	Lime.
KINDS OF GREEN FODDER.										
Grass, before blooming	75.0	22.9	2.1	3.0	12.9	7.0	15.9	0.8	0.18	0.30
Grass, end of blooming	69.0	29.0	2.0	2.5	15.0	17.5	17.5	0.7	0.15	0.30
Red clover, before blooming	83.0	15.5	1.5	3.3	7.7	4.5	11.0	0.7	0.11	0.44
Red clover, full blooming	78.0	20.3	1.7	3.7	8.6	8.0	12.3	0.8	0.11	0.53
White clover, full blooming	80.5	17.5	2.0	4.5	7.8	5.0	12.3	0.6	0.15	0.52
Swedish clover, beginning of blooming	85.0	13.5	1.5	3.3	5.7	4.5	9.0	0.6	0.10	0.40
Swedish clover, full blooming	82.0	16.2	1.8	3.3	6.3	6.6	9.6	0.6	0.13	0.48
Lucern, tender	81.0	17.3	1.7	4.5	7.8	5.0	12.3	0.6	0.14	0.49
Lucern, in flower	74.0	24.0	2.0	4.5	7.0	12.5	11.5	0.7	0.15	0.70
Honeysuckle, in flower	80.0	18.5	1.5	3.2	8.8	6.5	12.0	0.6	0.14	0.45
Clover, incarnate, in flower	81.5	16.9	1.6	2.7	6.7	7.5	9.4	0.6	0.12	0.56
Clover, hops, in flower	80.0	18.5	1.5	3.5	9.0	6.0	12.5	0.8	0.12	0.45
Saradella, in flowers	80.0	18.7	1.3	3.6	7.0	8.1	10.6	0.4	0.11	0.40
Peas, in flower	81.5	17.0	1.5	3.2	8.2	5.6	11.4	0.6	0.11	0.45
Vetches, in flower	82.0	16.2	1.8	3.1	7.6	5.5	10.7	0.6	0.12	0.51
Oats, in flower	81.0	17.6	1.4	2.3	8.8	6.5	11.1	0.5	0.11	0.12
Rye, green fodder	72.9	25.5	1.6	3.3	14.9	7.3	18.2	0.9	0.13	0.10
Maize, early cut	82.2	16.7	1.1	1.1	10.9	4.7	12.0	0.5	0.08	0.07
Millet, sugar	74.0	25.1	0.9	2.5	15.3	7.3	17.5	1.4	0.08	0.07
White cabbage	89.0	9.8	1.2	1.5	6.3	2.0	7.8	0.4	0.12	0.24
Cabbage stems	82.0	16.1	1.9	1.1	12.2	2.8	13.3	0.3	0.12	0.30
Beet leaves	90.5	6.7	1.8	1.9	4.6	1.3	6.5	0.5	0.09	0.20
Carrot leaves	82.2	14.2	3.6	3.2	8.0	3.0	11.2	1.0	0.19	0.32
Elm and poplar leaves	70.0	28.0	2.0	6.0	15.5	6.5	21.5	1.5	0.16	0.45
Artichoke stems	80.0	17.3	2.7	3.3	10.6	3.4	13.9	0.8	0.14	0.45
ROOTS, ETC.										
Potatoes	75.0	24.1	0.9	2.0	21.0	1.1	23.0	0.3	0.15	0.03
Artichokes	80.0	18.9	1.1	2.0	15.6	1.3	17.6	0.5	0.14	0.04
Beets	88.0	11.1	0.9	1.1	9.1	0.9	10.2	0.1	0.09	0.03
Beets, sugar	81.5	17.7	0.8	1.0	15.4	1.3	16.4	0.1	0.08	0.03
Kohl Rabi	87.0	12.0	1.0	1.6	9.3	1.1	10.2	0.1	0.09	0.07
Carrots	85.0	14.0	1.0	1.5	10.8	1.7	12.3	0.2	0.08	0.08
Late (stubble) turnips	91.5	7.7	0.8	0.8	5.9	1.0	6.7	0.1	0.08	0.06
Turnips	92.0	7.2	0.8	1.1	5.1	1.0	6.2	0.1	0.08	0.06
Parsnips	88.3	11.0	0.7	1.6	8.4	1.0	10.0	0.2	0.07	0.06
Pumpkins	94.5	4.5	1.0	1.3	2.8	1.0	4.1	0.1	0.08	0.08

"The total amount of nutrition" of "early cut" corn is thus made to exceed that in Swedish clover, saradella, peas, vetches, and oats and lucern in flower, and leaves of the cabbage, beet, and carrot. "The amount of nutriment containing nitrogen" is less than that in the other

plants named in the list, while the fat-forming nutriment in green corn-fodder is greater than that in clover, lucern, saradella, peas, oats, vetches, cabbage, beet, or carrot, and is exceeded only by the best grasses, rye, millet, cabbage stems, and elm and poplar leaves.

It would seem, too, that in comparison with the English turnip, a root regarded as the sheet-anchor of British husbandry, the percentage of flesh-forming nutriment is the same, and of fat-forming material nearly double, in the maize, while the amount of water is less than half as much. The reader can pursue the comparison with other plants or roots named, making his own deductions, remembering that flesh cannot be placed upon animals at will, in exact proportion to weight of nutriment fed, as determined by chemical analysis, but that a thousand circumstances in the condition of the material fed, the manner of feeding, and the vital forces of the animals themselves, must modify, in some degree, every experiment made.

Mr. J. H. Salisbury, of New York, who has made analyses of maize in every stage of its growth, gives the following as his average of analyses made just before the formation of the ear, (calculated without water):

Sugar and extract	35.00
Matter obtained from fiber by a weak solution of potash	12.00
Dextrine or gum	6.04
Albumen and casein	7.96
Woody fiber	39.00
Total	100.00

Mr. Salisbury arrives at the following conclusion as to the feeding value of this fodder: "The plant, during the tasseling, owing to the very large percentage of sugar and extract, with the respectable quantity of albuminous matter and dextrine which the stalk, leaves, and sheaths contain, must afford a very palatable as well as nutritious fodder."

CONCLUSIONS.

The following conclusions may be derived from the facts presented:

1. Green corn-fodder is neither worthless nor the poorest of all soiling material.

2. It is best when planted in drills or hills, not so thickly as to prevent normal growth and development, cultivated to destroy weeds and grasses, and cut between tasseling and earing, when the elements elaborated for production of the ear are stored in readiness for immediate use.

3. It is probable, both from the *rationale* of the case and from facts presented above, that in the more northern latitudes a mistake has often been made in sowing thickly southern corn which cannot mature, the fodder from which fed in August must be very nearly worthless. On the contrary, the fodder from northern corn, especially sweet corn, drilled widely and cultivated, and fed just before earing, is found to be very valuable.

4. Its value, compared with lucern, millet, the best grasses, and other plants containing a larger percentage of nutriment, taking into consideration the quantity produced and the cost of its production, has not been determined fully, and should be decided by a series of thorough and exhaustive experiments.

It is evident, from all that is conflicting in the opinion of different feeders, that the differences are mainly due to the degree of maturity or soundness of the corn. That from thick sowing, immature, colorless, and watery, is unfit to place before the cows of any well-regulated dairy. It is probable that half that is fed is either improperly cultivated

or in a stage of growth not productive of the highest results. If this should be the case, how stupid to condemn the maize for the ignorance of the cultivator. If it is found to contain too little nutriment for its bulk, or too small amount of the flesh-forming element, the suggestion found in the practice of some, of giving a small amount of more highly concentrated nutriment in connection with corn-fodder, is eminently wise. This is a deficiency easily remedied. While corn is our national crop, less fastidious in the circumstances of its growth than almost any other, and capable of yielding so largely under the proverbial neglect which characterizes our culture, let not this fodder be discarded until something of greater practical value is found, the superiority of which has been actually demonstrated under local circumstances of soil, climate, and cultivation.

THE PASTORAL LANDS OF AMERICA.

The interior of every continent comprises vast areas of dry and comparatively arid regions, where the rain- and snow fall is very small, and, as a consequence, where flocks and herds can graze both summer and winter. The great steppes of Asia furnish us the most notable instance of this kind, Since the times when "Abel was a keeper of sheep," and Abraham, Lot, and Laban had flocks and herds, the great elevated table-lands and plateaus of Asia have furnished pasturage for countless numbers of cattle and sheep. The Report of the Paris Exposition of 1866 estimates the production of wool in Asia at 470,000,000 pounds annually, which is produced exclusively by winter grazing, and without the stimulus of civilization, which its manufacturing and consumption demand. The grazing regions of Australia, South Africa, and South America have developed a wool production of astonishing magnitude within the past twenty years. In North America the region answering to the several countries named is that vast interior comprising both slopes of the Rocky Mountains, and embracing more than one-half of the total area of the United States. This immense pasture land extends from the Mexican boundary on the south to the British Possessions on the north, and from the twenty-first parallel of latitude west from Washington to the Pacific Ocean, and embraces an area of 1,000,000,000 acres. This country was the favorite herding ground of the buffalo in the pre-historic ages. Their bones lie bleaching in all directions, and their paths, deeply worn, cover the whole plains like a net-work, while their "wallows," deep pits in the ground, are still to be seen. Elk, antelope, and deer still feed here, and the mountain sheep are yet to be seen on the mountain sides and in the more secluded valleys of the Sierra Madre range—proving conclusively that this region has afforded winter pasturage from time immemorial.

This country is bisected into nearly equal portions by the lofty and snowy range of the Sierra Madre, or Mother Mountains, of the old Spanish explorers. This mountain range, in its windings, measures fully fifteen hundred miles in length, and from its snow-covered tops a thousand streams take their rise and plentifully water its mountain slopes. It is here that the Rio Grande, the Red, the Arkansas, the Plattes, the Yellowstone, and the Missouri on the east, and the Columbia, the Sacramento, the Humboldt, the Green, and the Colorado on the west, with their many tributaries, take their sources in the everlasting snows.

The soil of the country is produced by the disintegration of the limestone, sandstone, and granite ridges of this mountain range, and it is, therefore, dry, gravelly, and porous, except on the borders of the streams. Along the streams the soil is a dark mold, formed from the decomposition of the vegetation growing on the mountains. The grasses of the wide plains and valleys and the lower mountain sides are the bunch, buffalo, grama, mesquite, and in some valleys the blue-joint, red-top, and wild rye-grass. The grasses grow and flourish up to the timber and snow line—to an altitude of 10,000 feet. In addition to the grasses, there is a great variety of sweet, tender, and aromatic herbage, upon which sheep and goats delight to browse. Of the artemesia there are twelve to fifteen varieties, of which the wild sage furnishes five or six. There are four or five varieties of the sheep-sorrel; and of the wild pea-vine there is an extensive family. There are also many kinds of the wild dock and the balm.

The climate of this region is much like that of Asia. The rain-fall is light, being about eight inches annually in the country west of the Missouri River and east of the Sierra Nevada Mountains; while the snow fall, at the altitude of 7,500 feet, is only two feet. The fall of snow at any one time is small, and never lies on the ground to afford sleighing or to cover the grasses. The rainy season is in May and June, and after these months the only rain that falls is from electrical showers. While the rain is falling in May and June, vegetation grows luxuriantly; but, when the rains cease, the grasses gradually dry on the ground, so that by the time the frosts come, in September, they have become perfectly cured uncut hay.

The post surgeon at Fort Kearney, in response to circular No. 4 of the surgeon general's office, Nebraska, says of the country surrounding that post: "The average temperature for the year 1868 was 52° F. Snow does not remain any length of time." The report from North Platte station, Union Pacific Railroad, states that "the climate is healthful, and the extremes of temperature, on account of the dry and rarefied atmosphere, are well borne. The rain and snow fall are small." From Fort Sedgwick, Dr. Monroe, United States Army, reports: "The mean temperature for 1869 was 50° F., rain-fall 8.0 inches, snow-fall 10.32 inches. The atmosphere is usually dry. The prevailing winds are from the west." From Fort D. A. Russell, near Cheyenne, at the base of the Rocky Mountains, at an altitude of 6,100 feet, Dr. C. H. Alden, United States Army, reports: "The mean temperature for the past two years, 1868 and 1869, has been 46.53° F.; average annual rain-fall for the past two years, 6.25 inches." From Fort Laramie, Wyoming Territory, Dr. Schell, United States Army, writes: "The mean annual temperature is 50.6°. The climate is healthy, autumn and winter mild, summer dry and sultry, spring usually rainy." Dr. W. E. Waters reports from Fort Bridger, in the extreme western portion of Wyoming: "The climate is temperate and salubrious the greater part of the year; the weather during the fall months is mild and delightful, excepting a few storms of short duration. During the months of May and June there is a greater rain-fall than in all the other months. The rain-fall for the last year amounted to 7.97 inches." Dr. F. L. Town, of Fort Shaw, Montana Territory, in latitude 47° 30′ north, writes: "The climate of the Territory is exceedingly dry all the year round. The aggregate fall of rain and snow (melted) for the year 1868 was 10.14 inches. Snow rarely lies on the ground long after a storm. The mean temperature for 1869 was 47.35° F." Without multiplying testimony, the foregoing scientific authorities from the Army will prove conclusively that the climate is uniformly dry, that the rain

and snow fall are small, as in the interior of the other continents where there has been winter grazing through the whole historic period.

HISTORY OF GRAZING ON THE PLAINS.

From 1833–'34, when the first military posts were established west of the Missouri River, to the present time, thirty-six years, the animals used in freighting supplies to these posts have been wintered on these great plains and in the mountain valleys, with no food but the cured and uncut grasses, and no shelter but that afforded by the bluffs and hill-sides. In 1849 the great California emigration commenced, and continued for years. Thousands of oxen, horses, and mules, used in this emigration, were wintered in the valleys of the Rocky Mountain regions without hay or grain. The Mormons had previously moved to Utah in large numbers, and had wintered their stock through several seasons on the cured uncut grass alone, and with no artificial shelter. In 1857 General Johnston moved an army of several thousand men, with the usual number of citizen employés and followers, to Utah, and all the animals used in carrying supplies for this army were wintered in the valleys by grazing alone.

In 1859 the Pike's Peak emigration took place, and here also was winter grazing put to the test, and found successful. From that time until the building of the Union Pacific Railroad, the freighting to New Mexico, Colorado, Utah, Montana, and Idaho employed thousands of animals, which were wintered upon the uncut grasses. That winter grazing is certain, safe, and profitable, in all this vast Rocky Mountain region; that here are perennial pastures, "boundless, endless, gateless," where cheap beef and mutton may be raised to feed the millions of laborers who are to develop the wealth of this continent, and where all grades of wool may be produced to supply the great manufacturing industries of the nation, is proved by the experience of freighters, stock-men, and flock-masters, who have had an experience of a quarter of a century in that country. Mr. J. W. Iliff, of Cheyenne, Wyoming Territory, one of the most extensive stock-men of the plains, who is wintering 8,000 head of cattle without hay or shelter the present season, writes:

> I have been engaged in the stock business in Colorado and Wyoming for the past eight years, and consider the summer-cured grasses superior to hay. My cattle have not only kept in good order on this grass through all the eight winters, but many of them, thin in the fall, have become fine beef by spring. During this time, I have owned 20,000 head of cattle. The percentage of loss is much less than in the States, where cattle are stabled and fed on corn and hay. My experience in sheep has not been so extensive as in cattle. I think, however, that the short sweet grass and dry climate here are especially adapted to sheep-raising. I am confident, from experience, that this trans-Missouri country can defy all competition in the production of wool, mutton, beef, and horses.

Mr. Alexander Majors, of the freighting firm of Russell, Majors & Waddell, writes:

> I have been grazing cattle on the plains and in the valleys and mountains for twenty years, and during that time have never had less than 500 head of work cattle, and for two winters, those of 1857 and 1858, I wintered 15,000 head of heavy work-oxen on the plains each winter. My experience extends from El Paso, on the Rio Grande, to one hundred miles north of Fort Benton, in Montana. Our stock is worked during the summer, and comes to the winter herding-ground thin. There it grazes without shelter, hay and grain being unknown. By spring the cattle are in good working order, and many of them fat enough for beef. During these twenty years the firm with which I have been connected has wintered many cattle on hay and corn in Missouri and Arkansas, and I am sure the percentage of loss of those wintered in this country is less than it was in those States with food and shelter. The country west of the Missouri River is one vast pasture, affording unequaled summer and winter grazing, where sheep, horses, and cattle can be raised with only the cost of herding.

Mr. Edward Creighton, of Omaha, Nebraska, writes:

For eleven winters I have grazed more or less stock, including horses, cattle, and sheep, in Colorado, Wyoming, Utah, and Montana. Large work-cattle winter in the valleys and on the plains exceedingly well. We have no shelter but the bluffs and hills, and no feed but the wild grasses of the country. The last four winters I have been raising stock, and have wintered about 8,000 head. They have done remarkably well. We have had 3,000 sheep the past winter, and they are in the best order. I have been interested in stock-raising in the States for a number of years, where we had tame grass hay and fenced fields, and good shelter for the stock, and good American and blooded cattle, and an experienced stock-raiser to attend them, and after a full trial I have found that, with the disadvantage of the vastly inferior Texas cattle, and no hay, no grain, no shelter, nothing but the wild grass, there is three times the profit in grazing on the plains.

Mr. J. A. Moore, of Cheyenne, formerly a sheep-raiser in Ohio, writes:

I have been familiar with grazing on the plains for eleven years; have had experience with horses, cattle, and sheep, and have found no difficulty in wintering stock without shelter, except what is afforded by the cañons and the bluffs. My loss in winter has been less than during my experience in stock-raising in Ohio. I have now 8,000 sheep which have wintered well on the native grasses. Since bringing them to this cool and elevated country, they have increased in the quantity as well as in the quality of wool. I know of no disease which prevails among sheep in this country. Out of these 8,000 sheep I have lost only two by wolves. This region is peculiarly the home of the sheep. I can raise wool here for less than one-half its cost in Ohio or other Eastern States.

General L. P. Bradley, United States Army, who has been on duty at various posts in that country, says:

The value of this country for grazing may be estimated from the fact that good, fine grasses grow evenly all over the country; that the air is so fine that the grasses cure on the ground without losing any of their nutriment; and that the climate is so mild and genial that stock can range and feed all the winter, and keep in excellent condition without artificial shelter or fodder. The fact of grasses curing on the ground is a well-known peculiarity of all the high country on the eastern slope of the mountains, and in this consists the great value of this immense range for grazing purposes. I believe that all the flocks and herds in the world could find ample pasturage on these unoccupied plains and the mountain slopes beyond; and the time is not far distant when the largest flocks and herds in the world will be found here, where the grass grows and ripens untouched from year to year.

The following is from the message of Governor Campbell, of Wyoming:

In the chosen home of the buffalo and other graminivorous animals which have for unnumbered years roamed over our plains, and subsisted on the succulent and nutritious grasses, it would seem superfluous to say anything in relation to our advantages as a stock-growing country. In a climate so mild that horses, cattle, sheep, and goats can live in the open air through all the winter months, and fatten on the dry and apparently withered grasses of the soil, there would appear to be scarcely a limit to the number that could be raised.

This testimony is conclusive upon the point of the practicability and reliability of the winter grazing of a country greater in extent than all the States east of the Mississippi River.

The year 1870 is the first in which the people of this region have been able to ship beef cattle to eastern markets. The Union Pacific Railroad the past season has been shipping cattle from the Rocky Mountains to the Chicago market, a distance of over a thousand miles, for \$6 to \$8 per head. From carefully prepared estimates, the following numbers of cattle have been taken into the Territories the past season: To Colorado, 36,000; to Montana, 20,000; to Idaho, 9,000; to Nevada, 12,000; to Utah, 10,000; to Wyoming, 11,000. These cattle are mostly from Northwestern Texas, and are stock cattle to be used in breeding by crossing with Short-horn and Devon stock. Grass-fed beef raised here, and very fat, is sold for \$3 per hundred, live weight, and such rates are proving to be very profitable to the raiser.

To show how cattle are managed, one or two cattle and sheep ranches and ranges may be described. The herds of Messrs. Edward Creighton, Charles Hutton, and Thomas Alsop are grazed on Big Laramie, a tributary of the North Platte. The Laramie Valley lies between the Black Hills and the Medicine Bow range, and is about one hundred miles long by thirty miles wide. About midway in this valley and six miles from the railroad station at Laramie, these gentlemen have located their stock ranches, where they have extensive houses, stables, and corrals. Leaving the station, we follow up the windings of the Laramie on a smooth road, which is like rolling the wheels over a floor. The stream is clear as crystal, and pure as the snows from which its waters come. We first meet a herd of 4,000 half and three-quarters bloods, that is, none more than half Texan and many only a quarter, known among cattle-dealers as Short-horn Texas cattle. There are 1,000 calves in this herd that are one-half to six-eighths Short-horn. The cattle have been on the plains one winter and two summers. All the dry cows are exceedingly fat, and many of those with calves at their sides would make good beef, while many of the two-year-olds and yearlings are fit for the butcher, so far as condition is concerned. The herd contains 4,000 cows, 3,600 beeves, 1,000 two-year-olds, and 500 yearlings. The cattle range over a country fifteen by twenty miles in extent. The cows and calves run together the year round. In fact they are never separated, but run in families of four generally—cow, calf, yearling, and two-year-old. These cattle are to be found on river bottoms in the middle of the day, where they come about 11 o'clock for water. They return about 4 o'clock in the afternoon to the high grounds where the rich bunch and grama grasses are abundant, and feed till night, when they lie down on the warm sandy soil till the next morning, and then feed again till the heat of the day. The habits of these cattle when unrestrained by herders is interesting. They travel back and forth to the water and grazing ground in families and little herds, in single file, like their predecessors on the soil, the buffaloes, and like them forming deep paths or trails.

Passing over the river from this herd, we come to the beef herd, which consists of 3,500 Texas cattle, in the best condition to which grass-fed cattle can be brought. These cattle have been here one or two seasons, and will weigh, on an average, 1,300 pounds live weight. Still higher up the stream, and nearer the mountains, there is a stock herd of yearlings and two-year-olds. Crossing to the Sand Creek, a small branch of the Laramie, we find a herd of American cattle which, including Hutton's and Alsop's, numbers 400, mostly cows, and as fine stock as can be found anywhere. In this herd are several fine graded Short-horn bulls and two thorough-breds that were bought in Ohio at high prices. The parties named are owners of 300 blooded bulls, from which the finest calves are being raised by the cross between them and the graded Texas cows. These calves show the Short-horn clearly in every instance, giving another proof of the general law that the stronger and better blooded of two races will give form and impress to the progeny. This fact is strongly illustrated in these herds, the second and third crosses having no traces of the Texan blood. On this ranch are 300 brood mares and some young stock, yearlings and two-year-old colts, which have been raised here, and have never been fed or sheltered. These colts are as large and fine as any raised elsewhere. The brood mares and colts are herded, but are neither stabled nor fed in winter. The flock of sheep numbers more than 13,000 head, including 3,000 lambs. A portion of this flock is from New Mexico, but the great majority is from Iowa, and consists of fine Merino sheep, averaging five pounds of

wool per head. Ample shelter has been provided in case of storms. These flocks consist chiefly of ewes. The owners expect to raise 6,000 lambs and to shear 65,000 pounds of wool next year. These parties have about fifteen miles of fence, inclosing hay grounds, pastures for raising stock, and for other purposes. They have more than $300,000 invested. Behind Sheep Mountain and directly under the white top of Mount Dodge, at the head of the Little Laramie, is a valley twenty miles long and ten miles broad, divided about equally by the north, middle, and south forks of that stream. These are rapid-running streams, that never freeze in winter. They have groves of timber on their banks and bottom lands, furnishing shade in summer and shelter in winter. This valley is a pocket in the mountains, having only a narrow point of ingress and egress. Here are 2,900 head of cattle owned by Messrs. Lambard, Gray, Coates, and Latham. Three men are able to herd them, from the nature of the valley, and it is certainly a cattle paradise. Of this herd, there are 1,200 cows, 700 two-year-olds, 300 yearlings, and 700 calves. This herd is Short-horn Texan, and is a good lot of stock cattle.

Near Cheyenne, Wyoming, Mr. J. W. Iliff has large herds. His cattle range down Crow Creek to the Platte, a distance of twenty to thirty miles. On this grazing ground he has 8,700 head of cattle, classed as follows: Three thousand five hundred beeves, 2,000 cows, 2,000 two-year-olds and yearlings, and 1,200 calves. The stock cattle are half-breeds, except the yearlings and calves which he has raised, and which show the Short-horn cross. The beeves are heavy fat cattle, averaging in live weight 1,200 to 1,400 pounds. The whole range down Crow Creek, from Cheyenne to the Platte, affords the best grasses, and the Creek bluffs shelter the stock completely from storms. Mr. Iliff has been the owner of great herds of cattle in the last twelve years, and is firm in the faith that this is the place to raise beef for the eastern markets. His cattle have been sold in the Chicago market at 5 to 6 cents per pound, live weight, this season. The whole 3,500 head of beeves will be shipped east this fall. In such a country of boundless pastures, where the only cost of raising beef is that of herding the cattle, and where the facilities are so great for reaching markets by railroads, there is no reason why in the next ten years this region should not furnish beef and mutton at one-half the present market prices. What is now most needed is a refrigerator in which slaughtered beef can be carried from the Rocky Mountains to the Atlantic coast, and be delivered as fresh as when it is started. When this can be done, the supply of good beef and mutton will be limited only by the demand. With the present stock limited as compared with the great herds that are destined to graze on the great plains and in the thousand valleys of the great mountain ranges, there are beef cattle enough now west of the Missouri to materially lower the market prices in eastern cities, if beef could be transported at low rates and on time contracts. At several points on the line of the Union and Kansas Pacific Railroads there are parties who would contract to place on the cars the very fattest of beef at $6 to $7 per hundred pounds in the quarters, "all round." This beef could be delivered in the Boston, New York, Philadelphia, and Washington markets at $7 50 to $8 50 per hundred pounds, and be retailed to all classes at 12 to 15 cents per pound.

WOOL-GROWING.

This section is also adapted to the growth of all kinds of wool. We are importing large quantities of wool and woolens; and while our population is increasing, the number of sheep in the United States has of late

been decreasing. In the State of Ohio, in the two years from 1867 to 1869, the number of sheep decreased 2,570,000. In all the States where sheep were kept only for wool-growing the decrease has been quite as rapid. The causes are, the high price of land, the great cost of raising hay and grain, and the length of time during which sheep require feeding through the winter. Wool costs so much when grown under such circumstances that there is no profit in raising it at ordinary market rates. The wool-growers of Australia, South Africa, and South America can grow wool and transport it thousands of miles, pay a high duty, and then undersell our wool-growers in market. They have no high-priced land to pay interest upon, and no high-priced hay or grain to feed through long winters, as they graze in all seasons. We must of necessity, therefore, if we grow wool at all, develop the resources of this great interior pasture land. In this region wool can be grown as cheaply as it can be produced in Australia and South America. The climate is dry, with an entire absence of long, cold rain-storms, from which sheep suffer so much. The atmosphere is cool and bracing, and the soil is dry, gravelly, and porous, with an abundance of short, sweet grasses and tender herbage throughout the year. Professor Daniel C. Eaton, of Yale College, states that the flora is identical with that of Angora and Cashmere which alone has produced the dazzling whiteness of the fleece of the Asiatic goat. The climate, soil, and vegetation of Australia are like these mountain regions, except that the climate of the latter is cooler, with less rain.

There seems to be no reason why not only the common clothing-wools, but also the long Merino combing-wools of Australia and the delaine wools of New Zealand should not be grown in the pastoral regions under consideration. Hon. J. B. Chaffee, of Colorado, writes:

> I regret that I am not sufficiently posted in regard to the sheep-growing husbandry of Colorado to enable me to give you facts and figures more definitely. The number of persons engaged in stock-raising is increasing so rapidly that the fact of its being a very remunerative business would seem to require no other demonstration. In one county (Conejos) out of the twenty-one counties of Colorado, over [illegible] sheep were grazing at one time last summer, and I do not think 1,500,000 would be an overestimate for the whole Territory. The climate and soil being dry, and the latter also gravelly and porous, and the grasses being very nutritious, with a great variety of food in the various aromatic plants of the country, sheep are scarcely liable to disease. It is undoubtedly one of the most natural and best adapted sheep-growing countries in the world, and I think this is the universal testimony of those best acquainted with stock-raising who have visited Colorado in the last few years. In the southern portion of Colorado the only expense is herding, the sheep subsisting upon the natural grasses of the country in the winter as well as in the summer, no preparation of hay or food being necessary. The net profit is reckoned, after deducting every expense, at not less than 40, and by some at 75 per cent. per annum upon the investment, taking the price of wool as at present rated—about 12 cents per pound. Woolen manufactories are springing up, which will increase the price of wool by creating a better market; and at no distant day this region may become one of the most extensive woolen manufacturing countries on the continent. The eastern slope of the Rocky Mountains, including Wyoming, Colorado, and New Mexico, is doubtless the best sheep-growing country on this continent, and probably in the whole world, and is capable of grazing more sheep, and at less cost, than all the rest of the United States. At present the hostile Indians are the only drawback, and it is hoped that the railroad system now so rapidly being developed, with the careful and judicious management of Indian affairs by the present administration, will render the business comparatively, if not perfectly, safe in all this vast country within a short space of time.

Hon. John M. Thayer, of Nebraska, writes:

> I am sure that wool can be grown on the Rocky Mountain slopes equal in fiber to the best wools of Australia, Saxony, Silesia, or Moravia, and at as low cost as any wool can be grown in the cheapest pastures of the world, and still leave a wide margin for profit. We ought to grow wool there not only for our own use, but for the use of the world. When we grow the necessary fibers of wool, I have no doubt that we shall

then be able to produce cheap and fine woolen fabrics at prices that will enable us to compete with those of any other country.

Of the wool-growing of Utah, Hon. W. H. Hooper writes:

The climate, grasses, and topography of Utah render it one of the best sheep-producing localities in the whole range of the States and Territories; and in this respect what I say for Utah will almost equally apply to the entire Rocky Mountain country. Sheep when well wintered and cared for prove to be healthy and prolific, affording the finest mutton I have ever eaten, and their fleeces are superior in quantity and quality. The people of our Territory have from necessity given to the subject of sheep husbandry a full and careful test. Their destitute condition on arriving at Salt Lake compelled them to give early and thorough attention to home productions, as their fine flocks of sheep and their numerous woolen and cotton factories, which followed the settlement of that region, will attest. I think there are now running five woolen factories which are far behind in working up the wool product. Other factories are now being built. One of them, designed to run 3,000 spindles, is intended for the manufacture of a finer class of goods than any yet produced in the Territory. I am satisfied that we shall soon be able not only to clothe our present population with these home products, making the investments at the same time self-sustaining and profitable, but be able to provide for the large influx that is yearly adding to our numbers. We are pleased to know that with these additions are many skilled workmen in woolens, as well as in other branches of mechanism. One very advantageous feature of the Rocky Mountain range in sheep-growing is the adaptability of our many valleys to the raising of roots, which afford good food and enable sheep-owners in the higher and more northern portions to feed well, and thus render more certain a large number of lambs and also large fleeces.

Hon. Roscoe Conkling, of New York, writes:

On all occasions of traversing the plains—and I have crossed them several times—my attention has been attracted to the adaptation of the country to flocks. Indeed, the most broken, abrupt, and waste places seemed to me available for sheep-grazing.

Hon. William Lawrence, of Ohio, says:

I have been and am yet somewhat interested in raising sheep and producing wool in Ohio, and have given some attention to the subject. On the eighth of April last I expressed my opinion of the future of sheep husbandry in this country, in a speech made in Congress, and which opinion I yet believe to be correct. I then predicted that the interior of this continent would, in a few years, produce nearly all the wool that would be required in the United States for our home supply; and, in fact, I do not entertain any doubt that in twenty years enough wool can be raised to supply not only the home demand, but enough for all the export trade that this country can command. In August, 1868, I passed over the railroad from Omaha to San Francisco. I stopped at Laramie, in Wyoming Territory. There I saw a herd of 4,000 cattle and some 3,000 sheep, grazing in Laramie Valley, in healthy condition and good order. The Laramie Valley is about one hundred miles long and thirty wide, as I there learned, covered mainly with short but very nutritious grasses, well adapted to raising cattle and sheep. The climate, as I learned, was generally cool, with a healthy, bracing atmosphere, with nothing to produce disease either in men or in stock. I mention this valley because I examined it more carefully than any other; but from what I saw and learned, I am satisfied that a large part of the great central interior of this continent is of the same description of land. I cannot doubt that this is in a few years to become the principal sheep-producing region of this country. Sheep can be raised without expense, save for herding, and in some places the cost of cutting enough grass along the streams for hay to feed a short time in winter; while in much of this vast region, as I learn, sheep can be kept the year round in good order without hay or grain, simply by grazing. I cannot doubt that in a few years wool will be produced so cheaply and in such quantities that it will not be imported from abroad.

When our home supply of wool shall be thus increased and rendered as cheap as wool can be imported, or cheaper, I cannot see why this may not become the greatest manufacturing country in the world. With the cheapest wool in the world, and a vast supply of agricultural products, woolen manufactures must spring up in great abundance, and the United States will become exporters, instead of importers, of woolen goods.

Hon. J. Francis Chaves, of New Mexico, writes:

Without having the data before me, and judging only from what I know of the Territory of New Mexico and the large sheep-owners in it, I am satisfied that I do not overestimate the numbers in stating them at 1,500,000 head of ewes. The climate is temperate and salubrious, no disease being known. Sheep are herded and grazed from one portion of the Territory to another during the same year, thus adopting

what may be termed the migratory plan. The climate is dry and the soil is gravelly; producing the most nutritious grasses and shrubs: of the former the grama and the bunch grass, of which there are two or three varieties; and of the latter, the various kinds of sage, which make the best and most nutritious browsing; besides a large amount of underbrush and reed grass in the mountains. Were it not for the insecurity of life and property, caused by the wild marauding bands of Indians, especially the Navajoes, but a few years would elapse before the hills and plains of New Mexico would be literally covered with fleecy flocks. It is but a few years back, and within my own recollection, when nearly 1,000,000 sheep were annually driven to market in Southern Mexico from our Territory. At that time sheep were worth but 25 cents a head, and all those engaged in the business made money. That prosperity in the history of New Mexico was superinduced by twelve years of uninterrupted peace with the Navajoes. A sheep-raiser in New Mexico can safely calculate on an annual increase of 80 per centum, and, notwithstanding the coarse quality of the wool of the present stock, can herd his sheep and make a profit from the product of his wool and have all the increase of his stock in addition to this. I have no hesitation in saying that if peaceful relations are established with the Indian tribes, New Mexico can fairly compete with Australia, South Africa, and South America in the production of cheap wools. This statement may appear to you somewhat exaggerated, but I assure you that it is within reasonable bounds. I was born and reared in New Mexico. My friends and relatives have always owned sheep, and I myself have been an owner of this kind of property, and therefore, to a great extent, speak from personal experience.

This mass of testimony ought to be conclusive and satisfactory as to winter grazing and the great future of the Rocky Mountain region as a grazing country. The great valley of the North Platte is worthy of particular description. The distance from the mouth of the North Platte, where it joins the South Platte on the Union Pacific Railroad, to its source in the great Sierra Madre which, with its lofty sides, forms the North Park in which this stream takes its rise, is more than eight hundred miles. Its extreme southern tributaries head in the gorges of the mountains one hundred miles south of the railroad, and receive their waters from the melting snows of these snow-capped ranges. Its extreme western tributaries rise in the Wind River range, sharing the crystal snow-waters from the continental divide with the Columbia and Colorado of the Pacific. Its northern tributaries start oceanward from the Big Horn Mountains, three hundred miles north of the starting point of its southern sources. It drains a country larger than New England and New York together. The main valley of the North Platte, two hundred miles from its mouth, to the point where it debouches through the Black Hills into the great plains, is, on an average, ten miles wide. Nearly all this area, two thousand square miles, is covered with a dense growth of grass, yielding thousands of tons of hay. The bluffs bordering these intervals are rounded and grass-grown, gradually smoothing out into great grassy plains, extending north and south as far as the eye can see. The tributaries on the north side of the Platte are the Blue Water, Cold Water, Hill Creek, Raw Hide, Muddy, Willow, Shawnee, Slate, and Sweet Water. On the south, they are the Ash, Pumpkin, Larran's, Dry, Horse, Cherry, Chugwater, Sybelle, Big Laramie, Carter, Cottonwood, Horseshoe, Elk Horn, La Prele, Boisée, Deer Creek, Medicine Bow, Rock Creek, Douglass, North, South, and Middle Forks of the main Platte. These streams, with their smaller feeders, intersect in all directions a great pastoral land, interspersing it with rich fertile valleys, draining at least 40,000,000 acres, and affording water for countless herds. Most of the banks of these streams are bordered with timber. Cattle have been wintered on these streams north of Cheyenne, along the base of the Black Hills and around Fort Laramie, for twenty years.

Of this country Mr. Alexander Majors, in a recent letter, says:

The favorite wintering ground of my herds for the past twenty years has been from the Cache à la Poudre on the south, to Fort Fetterman on the north, embracing all the country along the eastern base of the Black Hills.

It is to this country that Mr. Seth E. Ward refers, when he says:

I am satisfied that no country in the same latitude, or even far south of it, is comparable to it as a grazing and stock-raising region. Cattle and stock generally are healthy and require no feeding the year round, the rich bunch and grama grasses of the plains and mountains keeping them, ordinarily, fat enough for beef during the entire winter.

All this region east of the Black Hills is at an elevation of less than 5,000 feet. The mean temperature, as recorded at Fort Laramie for a period of twenty years, is 50° F. Colonel C. H. Alden, post surgeon at Fort D. A. Russell, speaking of this region, says:

The largest snow-fall, so far, in one month, has been 3.097 inches. The snow in this vicinity rapidly disappears after falling, and there is rarely a sufficient quantity to afford sleighing.

All this country of the North Platte, east of the Black Hills, is within a short distance of the railroad at Cheyenne, Pine Bluffs, or Sidney. An abundance of timber can be had in the Black Hills for fencing and building purposes for all ranch and stock men in any of those valleys.

There is in the North Platte Basin, east of the Black Hills, an area of at least 8,000,000 acres of pasturage, with the finest living streams, and good shelter in the bluffs and cañons. These 8,000,000 acres of pasture would feed at least 8,000,000 sheep, yielding 30,000,000 pounds of wool, worth $7,500,000. Now that amount of money, instead of going to build up ranches, stock-farms, storehouses, woolen-mills, and all the components of great and thrifty settlements, is sent by our wool-dealers to South America, South Africa, and to Australia to enrich other people, while our wool-growing resources remain undeveloped. With any number of these immense valleys contiguous to railroads, timber, and coal, open to settlement, and with a demand for all the beef, mutton, and wool that can be produced, it is impossible to foresee the grazing wealth that is to be developed in the Rocky Mountain country within the next ten years.

THE DAIRY.

PROGRESS OF CHEESE MANUFACTURE.

During the year 1870 a large addition has been made to the number of cheese factories in the United States. In New York alone there are reported to be two hundred more factories than in 1869, and the increase in the West has been remarkable. The tendency, however, being toward smaller factories and the carrying of milk shorter distances than in past years, a large proportion of the establishments recently erected in the older dairy districts, especially in New York, have withdrawn territory from other factories, while still another portion have absorbed private dairies. In addition to these influences, which modified the business of the season, protracted drought lowered the average production of individual factories. Notwithstanding these cirumstances, the cheese product of the United States for 1870 is decidedly larger than that of 1869, some authorities estimating the excess as high as 17 per cent. This increased production, combined with unwise management by producers in pushing forward large quantities of cheese during the warm weather, thus overstocking the market at the most unfavorable season, caused a marked decline from the prices of 1869. The depressing effect of overstocking the market was aggravated by the inferior keeping qualities of the cheese made during the extreme heat of July and

August; and the losses experienced on the product of this trying term caused experts to renew more emphatically the declaration that a proper curing on the shelf is the great desideratum of American cheese manufacture at the present time.

A point worthy of notice, in reviewing the dairy business of 1870, is the diversion which has been made in some sections of the country from butter to cheese manufacture—a result due mainly to the rapidly increasing prosperity of the latter interest. It is probable that if the temporary depression which visited the cheese interest in 1870 had been foreseen, the diversion would not have occurred. The unfavorable results of this diversion enforce a fresh warning against sudden changes from one branch of dairy manufacture to another. Butter factories which possess fair market facilities, and have made satisfactory progress in establishing a good reputation for their butter, should not be changed to cheese factories without careful consideration, at a time when the prices of cheese are presumptively as high as they will go, and when so many new sources of cheese production are being developed.

CREAMERIES—BUTTER AND CHEESE FROM THE SAME MILK.

Mr. L. B. Arnold gives the following description of the working of "creameries," or factories which make butter and cheese from the same milk—a branch of dairying industry which was entirely unknown in this country a few years ago:

There are different modes of managing milk in creameries. In some the milk is set in the cheese vats at night, and stirred and cooled as if the whole contents of the vats were to be made into cheese in the usual way. It is then left standing, at 60°, as near as may be, through the night for the cream to rise. In the morning the cream is taken off and made into butter, and the skim-milk is mixed with new milk that is brought to the factory in the morning, and made into cheese. In this class of creameries there are two modes of working the cream into butter. One is to churn the cream as soon as it is taken from the vats, while it is sweet, and then put the buttermilk back into the vats with the milk, and work it into the cheese. In this way the valuable properties of the milk are worked up very closely, leaving nothing but a very poor whey. The other mode is to set the cream aside till it becomes sour, before churning. In this case the buttermilk cannot be worked into the cheese, and of course is cast out with the whey. In the former case the cheese always receives a peculiar flavor from the buttermilk, which some people fancy, but which most people dislike, and hence it does not find favor in the general market. In the latter case, if the curd is cured rapidly and without any cessation in the curing process, by exposing it to a temperature too low, the cheese can scarcely be distinguished from whole-milk cheese; and where unprejudiced selections are made, it is often preferred for its better keeping qualities and the purity of its flavor.

The butter in the two cases differs as much as the cheese. When milk is set for the cream to rise, the odor peculiar to new milk escapes slowly, and as the cream soon coats over the surface of the milk, the odor, in attempting to rise, becomes entangled in the cream, and is hence carried with it into the churn. In the process of churning much of the so-called animal odor escapes, but enough is always left in to modify the fine flavor of the butter, and to serve as a ferment to work its early destruction.

In the other case, where the cream is kept till it is sour, the acidity developed neutralizes the objectionable odor and destroys it, and leaves the butter with a better flavor and in a better condition for long keeping. As the best of the cream rises first, the butter made from this partial skimming is of the finest quality, and usually sells at an advance above dairy butter, when equal skill is used in its production.

The amount of butter taken from milk in this way is, perhaps, about one pound from 100 pounds of milk, in the middle of the season, increasing to a larger percentage as the milk grows richer in the fall. By this practice, the pounds of butter and cheese counted together generally exceed the number of pounds of cheese that could be made from an equal quantity of unskimmed milk. This difference may be accounted for from the waste that always occurs in making whole milk cheese, by particles of cream escaping with the whey, and from the fact that more water is retained in a curd from skim-milk than in a curd from whole milk, when all other circumstances are the same.

The purpose in this class of creameries is to make only so much butter as will allow of making a fine quality of cheese. In another class of creameries the purpose is quite different. It is to make all or nearly all the butter that can be made from the milk,

and then to make a profit by converting the skim-milk into cheese instead of feeding it to swine. To accomplish this it is necessary to keep the milk sweet while it is standing for the cream to rise. Cold water is the agent employed. At a temperature of about 60° the lactic ferment hardly makes any perceptible advancement. Hence, if milk is kept at 60° or a little below, the cream rises readily and the milk is preserved for a long time in a good condition for cheese-making. To effect this a reservoir is made in the creamery with mason work laid up with water-lime or cement, and kept constantly full and of even temperature by a steady stream of water from a cool spring. The milk, as it comes to the creamery, is strained into a small vat and thence drawn into tin pails, 18 or 20 inches deep and eight inches in diameter, and the pails then set into the reservoir, which is just deep enough for the water to rise around the pails as high or a little higher than the surface of the milk. This is found to be a better way of keeping milk than to spread it out in shallow vessels. The cream rises as quick, and some contend quicker, in the deep as in the shallow dishes, and much less surface is exposed to be injured by drying. The exposure is so little that the cream always remains soft and thin, requiring to be dipped off instead of skimmed. The time of letting it stand in these pails varies in different creameries. In some the milk of one day is made into cheese the next, thus allowing the morning's milk to stand twenty-four hours and the evening's milk twelve hours. In others it stands forty-eight and thirty-six hours. When the cream is taken off it is set away to sour, and at the proper time is churned by an application of steam, horse, or water power. It is a singular fact that after all the trials made with the great variety of churns that are being continually introduced, the creameries and the best butter-makers all fall back upon the old dash-churn as the best, both for quality of product and convenience. Patent churns are in bad repute with the creameries. When the butter is taken from the churns it is thoroughly washed in cool water before salting. However much washing butter may be condemned by others, the practice works well in the creameries. The idea that water washes out the fine aroma of the butter seems to be more fanciful than real, and certainly much less injury is done to the texture by *washing* out the buttermilk than by *working* it out.

The working is usually done on an inclined slab, with a lever rounded on one side and held in its place by a universal joint at the lower end of the slab. The salting is generally lighter than in farm dairies, being usually only one pound of salt for 20 pounds of butter, and the inclined slab is used in working it in. The butter made at the creameries is generally of superior quality, and commands a high price, and is beginning to exert a controlling influence in the market. Creameries are educating the public taste to a higher standard.

Though much may be said of the excellence of creamery butter, little can be said of the excellence of cheese made in this class of factories. Though rich in valuable nutriment—that might under more faverable circumstances be at least palatable food—the shape in which it now usually goes to market rates it very properly with the poorest class of human food. It is so dry, and hard, and insipid, and indigestible as hardly to be reckoned as a wholesome means of sustaining life. It is little else than dried curd. It cures so slowly and dries out so quickly that the cheesing process is arrested before it is hardly begun. There is a wide field open for improvement in the manufacture of skim-milk cheese. The valuable flesh-forming material with which it abounds ought to be and will ere long be presented in more attractive forms. I have no expectation that a fancy article will be made from thoroughly skimmed milk, but am confident that a cheese much more palatable and wholesome than those now made in creameries can be made from milk in the condition in which it is there manufactured. The most that is needed is to make the cheesing process as complete as in curing other cheese. When dairymen shall have become familiar with the fact that the cheesing process is but the result of the continued action of the rennet upon the coagulum it has formed from the milk, they will find some efficient way of keeping up that action, however much it may be retarded by depriving the curd of the stimulating influence afforded by the fatty matter in the milk. When the manufacture and curing of skim-milk cheese shall be adapted to the altered condition of the milk, its value will be greatly enhanced. But even now the dried curd, if I may so call it, makes a better return than can be made by feeding the milk to pigs or calves. It requires just about four times as much milk to make a pound of pork or veal as it does to make a pound of skim cheese, while there is but little difference in their market value. The quality of milk varies so much that no precise results can be stated when it is worked up in the different ways of manufacturing it, but they will not vary much from the following: Ten thousand pounds of milk, of average quality, will make 1,025 pounds whole-milk cheese. The same quantity, if partially skimmed, will make 100 pounds butter and 975 pounds cheese that will scarcely differ from whole-milk cheese. If deeper skimmed, it will make 250 to 300 pounds butter and 700 to 775 pounds skim cheese; or, if thoroughly skimmed, it would make 350 to 370 pounds butter and 600 to 650 pounds skim cheese. The cheese will vary considerably with the varying amount of milk taken off with the cream. If the whole-milk cheese be reckoned at 15 cents per pound, the partially skimmed will be worth 14 to 14½ cents, the deeper skimming about 9 cents,

and the full skimming 7 cents per pound. The butter in each case will keep with the top of the market as it fluctuates. The cost of making the cheese and getting it ready for market is 2 cents per pound, and the butter 5 cents. From the foregoing facts, the reader may gather at least a general idea of the *modus operandi* in creameries, and of the results produced. They give a little greater return than making cheese only from the milk, but, considering the greater outlay in building and apparatus, the results financially do not differ very widely. Their general effect upon the markets is to raise the standard quality for butter and to lower the standard of American cheese.

The Franklin Creamery, one of the largest butter and cheese factories in the State of New York, is situated in Franklin, Delaware County, four miles from the line of the Albany and Susquehanna Railroad. It commenced manufacturing in the spring of 1867. The property has cost between $8,000 and $9,000, and is owned and operated by a joint-stock company, the stock being chiefly held by the patrons. The ground dimensions of the main building are 60 by 38 feet, and of the wing, 44 by 28 feet. The building is partly three stories and partly two stories high, and includes dwelling-rooms. The water vat in which milk is set for cream measures 38 by 24 feet. There are four 600-gallon cheese vats, thirty presses, and sixteen churns, worked by a six horse-power portable engine. Butter is manufactured at 3 cents per pound, and cheese at 2 cents, patrons paying the expense of package, salt, &c., for butter, and of boxes, bandages, annatto, &c., for cheese. A report of the business of the factory for the season of 1869, commencing May 17 and ending October 17, a period of five months, is as follows: Quantity of milk received, 1,287,032 pounds; butter manufactured, 41,235 pounds; skimmed cheese manufactured, 80,217 pounds; quantity of milk to each pound of butter, 31.2 pounds; average price of butter delivered at railroad, 45.92 cents; average price of cheese delivered at railroad, 9.5 cents. After taking nearly all the cream for butter, the skimmed milk yielded nearly two pounds of cheese for each pound of butter. An analysis of receipts and expenditures for the season shows a net return of over 3½ cents for each quart of milk converted.

During the season of 1870, the average number of cows supplying the factory was 880; quantity of milk received, 2,310,569 pounds; butter made, 78,459 pounds; estimated quantity of cheese made, 138,000 pounds. Mr. Munson, the superintendent of the factory, informs us that the average price of their cheese in 1870 is much less than in 1869, owing to the overstocking of the market with skimmed cheese. The butter manufactured is mostly packed in Orange County pails, and though sold as creamery butter, is always classed with Orange County pail butter, bringing the same price, and averaging 5 to 10 cents per pound advance upon the price obtained for prime farm-dairy butter. During the season of 1870, it has brought an average of about 40 cents per pound, after deducting freight and commission in New York. Generally, the butter is sold as fast as it is manufactured.

The Elgin Butter Factory, Elgin, Illinois, established for the manufacture of butter and cheese from the same milk, went into operation July 11, 1870. The factory-building is 70 feet long by 32 feet wide, and is two stories high, with a basement of stone. Both stories are used chiefly for storing cheese. The basement is divided into three compartments. The first is devoted to the manufacture of cheese and the churning of cream for butter. For the latter purpose barrel churns are employed, the dashers being driven by steam power. The second compartment is used for working the butter, and as a room for setting the milk for cream. The third compartment is used for storing butter. It is provided with ice receptacles and has a stream of spring-water flowing through it, which keeps the air pure and cool. For setting and

cooling the milk there are in the milk-room two vats, each 16 feet long, 8 feet wide, and 23 inches deep. The water flows into these vats from two living springs and escapes from the top through underground drains. It has a uniform temperature of 53°. The milk is set in tin vessels two feet high and holding four gallons. These vessels are covered with screens of thin muslin. At the end of twenty-four hours the cream is dipped into similar vessels, where it remains the same length of time, during which it becomes slightly acid, when it is churned. The windows of the milk-room are darkened by curtains, and not a fly is allowed to enter. After the butter is churned it is cooled with ice. The working is done with wooden paddles, or with a bar working on a frame. In the intervals between churning and working and working and packing, the butter is placed in wooden trays, covered with muslin, and floated in one of the vats. The milk which is manufactured into cheese is allowed to retain a small proportion of cream. The cheese is manufactured chiefly for the New Orleans market. The price charged for making butter and cheese is 3 cents per pound.

During the month of November, 1870, the factory received 14,030 gallons of milk, and manufactured 4,666 pounds of butter and 9,340 pounds of cheese. The butter sold readily at wholesale for 40 cents a pound, with an increasing demand, while the best farm-dairy butter sold at 25 to 30 cents a pound. A statement of totals for the month is as follows:

4,666 pounds of butter, at 40 cents per pound,	$1,866 40
9,340 pounds of cheese, at 10 cents per pound,	934 00
Total value of butter and cheese	2,800 40
Cost of manufacture	420 18
Net proceeds	2,380 22

This exhibit shows a net return to patrons of nearly 4¼ cents per quart of milk furnished during the month. An average of one pound of butter and two pounds of skimmed cheese was produced from 12 quarts of milk.

An illustrative example of remunerative management of dairy products is found in the experience of the Orange County (New York) milk farmers, who, a few years ago, finding themselves at a disadvantage in the hands of middle-men, formed an association and established "creameries" convenient to railroad depots. After selling such milk and cream as could be disposed of at high prices, they converted the remainder into butter and "skimmed" cheese, each producer obtaining his proportion of the net profits arising from sales.

CONDENSED MILK.

The manufacture of condensed milk, now conducted to a limited extent, is stated to be very remunerative, and several prominent dairymen have indicated this specialty as offering a promising field for associated dairy enterprise. The article has already attained some commercial consequence, the export during the year ending June 30, 1870, amounting in value to $140,099. The following is a brief sketch of the process of manufacture, under the Gail Borden patent, employed in the Illinois condensing factory at Elgin:

Each consignment of milk, after passing examination, is strained and emptied into the receiving vat, whence it is conducted through another strainer into the heating cans, each of which holds about twenty gallons. These cans are placed in hot water until the milk reaches a temperature of 90°, when it is again strained and drawn into a large wooden vat, where

it is heated nearly to the boiling point by means of steam passed through a coil of copper pipe at the bottom of the vat. The milk then receives an addition of one and one-quarter pound of the best white granulated sugar to each gallon, after which it is drawn into a vacuum pan of 3,600 quarts' capacity, where it is again heated by steam for about three hours, losing 75 per cent. of its bulk. It is then drawn off into cans holding forty quarts each. These cans are set in a large vat containing water kept at a temperature equal to that of the milk they contain, and, when the temperature of the milk is reduced below 70°, it is emptied into large cans, and thence drawn into small cans holding one pound, which are immediately sealed to exclude air, and made ready for market. The wholesale price at the factory, in the latter part of the year 1869, was $3 50 per dozen cans, or a trifle over 29 cents per pound. Condensed milk is also prepared without sugar.

MISMANAGEMENT IN BUTTER-MAKING.

The exigencies of trade, especially of foreign demand, have wrought a very marked improvement in the quality of American cheese; but the butter of this country, notwithstanding the influence of emulation generated by association and the successful example of superior butter-makers, presents a low average of excellence.

Mr. F. D. Curtis, of Saratoga County, New York, in charge of the exhibition of dairy products at the New York State Fair in 1869, administered some severe reproofs to the butter-makers of the State as they were represented by exhibitors at the fair, and mentioned the following defects: Mixture of sour milk with the cream, causing rancidity in the butter; carelessness in putting down the several layers of the firkin or tub; neglect of proper precautions against injury from changes of temperature in transportation. Two-thirds of the butter marketed is damaged by such mismanagement, and depreciated in price. When exposed to sale, it is generally found that the lower portion of the contents of a tub is the poorest, and the discovery of this fact causes not only a diminution of price on the whole package, but also suspicion of intended deception. Yet no deception has been intended. The difference in quality has arisen from improper management of the lower layers, the upper layer having been kept in good condition by carefully covering it with salt when placed in the tub. When forwarded to market in warm weather, this imperfectly packed butter is placed in the low temperature of an ice-car, and on its arrival at the city depot it is often unloaded and carted under a broiling sun. The method of packing the best Philadelphia butter, which is put up in nicely stamped rolls, placed in tin pails with ice-reservoirs at top and bottom, and then packed in wooden tubs with closely fitting covers, nets the producer 40 to 50 per cent. more than is received for large and imperfectly marketed packages.

Behind all such errors of manufacture and handling of the product, lies the primary evil of mismanagement of the animal, the living machine of production. Neglect to provide shelter from burning suns; stinting of nutritious food in winter, after milking hard through the summer months; the use of close, ill-ventilated stables and scantily littered stalls, and carelessness in eliminating noxious weeds from pastures, lead to the most serious evils, abortion included, and are yet frequent among farmers who cannot justly plead want of information as their excuse. At no other period, perhaps, is want of care so injurious as at the time of "coming in." Mr. Harris Lewis, of Herkimer County, New York, remarks that, from the time cows commence coming in to the time of greatest yield of milk, (a period which may be assumed at three months'

duration,) there are more losses from accident, sickness, and death than during the other nine months of the year; and a large percentage of these losses is from want of care, want of proper food, and neglect of a judicious system of feeding. Such a system includes a liberal provision of the best grasses, if possible, and, when these are not attainable, such grass as may be had, with grain and other nutritious substances added. Meadow grasses, and red and white clover, cut in blossom and well cured, supplemented by roots, make excellent food. After coming in, cows should have not only good food, but also careful superintendence. They should be separated from those coming in, if it can be done without materially altering the temperature of the stable. They should be fed, watered, and milked regularly, by the same milkers, when practicable, and be carded daily when kept up.

DIFFERENCE IN YIELD OF COWS.

Mr. Lewis states that he has made many experiments on his own farm to test the value of the milk of cows at different ages for the manufacture of butter and cheese. He finds that the milk of cows from six to ten years old will produce 40 to 60 per cent. more cream than the milk of their offspring two years old, and that the specific gravity of the milk of old cows is 8 to 10 per cent. less than that of the milk of two-year-old heifers, the animals being fed and treated alike.

A writer in one of the western agricultural journals says that, on emigrating to this country from the Ayrshire region, he was astonished at the great inequality of yield among American cows, a single cow, perhaps, giving twenty-five quarts of milk daily, and six others of the same herd not more than ten or twelve quarts each, while Ayrshire cows in their native country will average twenty to twenty-five quarts daily for the first three months after coming in.

MILK SUPPLY OF CITIES AND TOWNS.

The milk supply of our cities and towns involves sanitary and economical considerations of the highest importance. The accompanying abstracts of reports of milk inspectors, and of others conversant with the milk business in various sections of the country, illustrate the magnitude of the interests involved in this branch of dairy farming, the abuses connected with it, and the methods used to counteract these abuses, the frequent disproportion between prices at first hands and the cost to city or town consumers, and the comparative profits to producers of marketed milk and milk manufactured into butter or cheese.

Inspection of milk in Boston.—The first act to punish fraud in the sale of adulterated milk in Massachusetts was passed by the legislature of that State during the winter of 1856. This act authorized any person to make complaint and to prosecute for violations of its provisions; but, as far as is known, no complaints were made. The law accomplished nothing. In the winter of 1859 a new law was enacted, which provided for the appointment in towns and cities of inspectors of milk, whose duty it should be to detect adulterations of milk and secure the conviction and punishment of offenders. Boston was the first municipality in the State to appoint an inspector whose time should be exclusively devoted to the performance of this duty, and it is believed that it was the first city on the continent to make the effort to secure a supply of pure milk for its citizens by arresting and punishing the venders of an impure article. The office of the Boston inspector was established August 10, 1859.

In March, 1864, the law was again revised. The new act forbade, under stated penalties, sales of milk produced from cows fed upon the refuse of distilleries, or any substance deleterious to the quality of the milk; it also forbade the sale of milk produced from sick or diseased cows; also the sale of milk adulterated with water or any foreign substance. City governments were required, and the authorities of towns were permitted, to appoint one or more inspectors of milk. Venders of milk were required to register with the inspectors their names and places of business. In 1868 the law of 1864 was so modified as to limit the imposition of penalties to persons selling milk known by them to be adulterated. It was soon found that this qualification opened the way to constant evasion, and rendered the law to a large extent ineffective. In addition to the immunity afforded to willful ignorance, was the difficulty of proving criminal knowledge. The public very naturally held that the crime of ignorance was not less culpable than the guilty knowledge, and that dealers should be held as responsible for one as for the other. In the following year, therefore, the distinction was annulled. By an act approved April 10, 1869, the sale, or possession with intent to sell, of adulterated milk was forbidden, under a penalty of a fine of not less than $20 nor more than $100. A similar penalty was imposed upon the sale of adulterated milk for manufacture into butter or cheese.

The following particulars are derived from the reports of Mr. Henry Faxon, inspector of milk for the city of Boston, for the period extending from March 31, 1869, to March 31, 1871.

Very few Boston milkmen produce on their own farms the milk which they sell. Two sources of supply are relied upon. Many are supplied from the stations at the termini of those railroads which bring milk from the country. Others live a few miles from the city, and at night go through their respective neighborhoods and collect a few cans each from small farmers. A few milkmen are supplied by large dairies. The quality of the milk collected near the city does not differ materially from that supplied by the railroads. Both kinds are regarded as good, fresh, family milk. Most of the milk used in Boston, however, is obtained through the railroads. The general plan of conducting the milk business on these roads is thus described:

Milk agents contract twice a year with the farmers for their milk, October 1 and April 1, and agree to pay monthly. Milk collectors are employed by the agents to collect the milk from the farmers' doors, and to deliver it at the door of the milk-car to the agent, who remains on the train. From the milk account of his collectors, and the dairy marks on the cans, he knows from whom each can of milk came. The milkmen receive their supply from the agent upon the arrival of the train at the city, paying him once a month. Some of this milk is distributed to consumers immediately; the remainder is conveyed direct to the stables of the milkmen and is packed in ice until its delivery at an early hour in the morning.

The supply is always equal to the demand, except during portions of July, August, and September, when it sometimes fails in part, owing to warm weather.

The milk-cans used for the conveyance and sale of milk by the dealers are of two classes, known as large and small cans. The large cans, which hold nine quarts and a pint, are in general use by the milk trade of Worcester County, and by many of those who collect their milk in the towns in the vicinity of Boston. The small cans, which hold eight quarts and one-half pint, are mostly in use on the Fitchburg, Lowell, and Eastern railroads. Many of the milkmen engaged in the family trade

have small cans, holding from a pint to four and six quarts respectively, which they fill from the larger cans to suit customers.

The prices of milk for 1868, 1869, and 1870 have been as follows: Summer rates, at the farmer's door, 4 to 4½ cents a quart; at depots in or near the city, 5 to 5½ cents a quart; delivered in cans at stores and shops, about 6½ cents a quart; retailed to families, 8 cents a quart. Winter rates, at the farmer's door, about 5 cents; retailed to families, 9 cents.

Adulterations of milk have been traced to all classes of dealers, except the railroad agents: to wholesale dealers, who distribute to families, stores, etc., from wagons; to retail dealers, who sell in small quantities from market places, stores, shops, and cellars; and to the milk producers. The foreign material of the adulterated milk is almost always water only. Salt is sometimes added to make up the loss in specific gravity, burnt sugar to alter the blue tinge of the watered milk, and carbonate of soda to prevent souring. During the winter few complaints of adulteration are made, but many that the milk is old, or that it has been skimmed. Poor families, for obvious reasons, are much oftener served with adulterated or inferior milk than the prosperous classes.

During the year ending March 31, 1870, 1,680 samples of milk were inspected, of which 520 were found to be more or less adulterated. Nineteen samples, subjected to chemical analysis, averaged 28.83 per cent. of adulteration, the largest percentage being 41.17. The supply of milk to the city during the year amounted to 7,646,020 gallons, at a cost to the consumers of $2,599,646 80.

During the year ending March 31, 1871, 1,700 samples of milk were inspected, of which 610 were found to be adulterated. Twenty samples analyzed by the chemist showed an average adulteration of 32.40 per cent., the largest percentage being 50.34, and the smallest 21.03. The number of gallons supplied to the city during the year was 8,510,340; daily supply, 23,316 gallons. The cost to consumers for the year was $2,893,515 60; daily cost, $7,927 44. The whole number of complaints in court from the enactment of the law to March 31, 1871, was 206; number of convictions, 135; failures to convict, 69; cases yet pending, 2.

The 1,700 samples of milk inspected during the past year, and the 610 samples that were found to be more or less adulterated, do not give the actual extent of adulteration throughout the city. The milk examined was supposed to be adulterated, or the inspector would not have been requested to test it. The quantity of milk adulterated and sold without exciting complaint can only be conjectured. It is a significant fact which the inspector states, that "in all the complaints carried before the courts during the past year for violations of the milk law, the parties pleaded guilty, paid their fine and costs, and were advertised, as required by the statute."

The price of milk at the farmer's door during 1870 averaged 4½ cents a quart; the price paid by consumers averaged 8½ cents per quart, or exactly 80 per cent. more than the farmer received. At the price obtained for their milk, farmers complain that they are not sufficiently compensated for their labor and capital invested. If they could receive some portion of the profits which the middle-men exact, they would have less cause for complaint, and consumers would not be so liable as they now are to an increase in price. Much attention is being given to various schemes for dispensing with the services of one or two classes of middle-men.

Inspection of milk in New York and Brooklyn.—Mr. C. F. Chandler, chemist to the metropolitan board of health, which has sanitary superin-

tendence of the district comprising New York, Brooklyn, and certain neighboring towns, has presented to the board a report concerning the results of investigations made by him in 1869 into the character of the milk supplied to consumers in that district, from which we glean the following facts:

During the year 293 specimens of milk were chemically examined. Forty-one of these were taken in the latter part of February from cans in the hands of milkmen arrested in the act of diluting milk. Four samples contained proportions of pure milk ranging from 37 to 60 per cent.; nineteen contained 80 to 97 per cent. of pure milk; the remaining eighteen were entirely pure, probably for the reason that the work of dilution had been interrupted. In addition to these forty-one cans, four cans filled with water were found in the hands of milkmen.

In April, seven samples of milk were collected at one of the crowded cow stables in Brooklyn. These samples were specially deficient in butter globules, and were in every respect inferior to the milk of healthy cows. No other indication of disease could be detected in the milk. The blood of the confined cows was found to be strikingly deficient in red corpuscules, containing from 2 to 6 per cent. more water than is present in healthy blood. Notwithstanding the fair appearance of these cows, they were not in a sound, healthy condition, and though analysis might fail to detect any specific poison in their milk, it could not be considered healthy food. Other large cow stables, to which the attention of the board had been called, were found to be overcrowded, dark, damp, and deficient in ventilation, but the animals kept in them generally presented a fair appearance.

In June and July, two hundred and ten samples purchased from retail dealers in various parts of the district were analyzed. In these the percentage of pure milk, as shown by the lactometer, varied from 37 per cent. to above the standard, averaging 72½ per cent.

During the last four months of 1869, thirty-five samples were examined, in which the percentage of pure milk ranged from 50 per cent. to above the standard, averaging 82.44 per cent. In these samples, as in all others analyzed during the year, water was the only adulterating substance discovered.

Mr. Chandler states that the average quality of the milk supply of the cities of New York and Brooklyn is represented by the addition of one quart of water to every three quarts of pure milk.

Milk production near New York.—In Essex and Union Counties, New Jersey, lying a short distance from the city of New York, and including within their bounds a large city and town population, the production of milk has become the leading agricultural interest.

Although the soil of these counties—a clayey loam, well watered by springs and streams—is admirably adapted to grazing, the high price of land, averaging about $300 per acre, necessitates a special system of feeding. The larger number of those engaged in milk production own only a few acres each, on which are kept from six to ten cows. A few herds number from twenty-five to thirty head, but a herd numbering fifty cows or more is rarely seen. From early in May to the middle of July, pasturage is largely supplemented by stable feeds of green rye, meal, bran, and brewers' grains. During the subsequent three months, corn-fodder is the main food, eked out with brewers' grains, etc. Rowen pasture is obtained in October. From November to the last of April, hay, turnips, grains, meal, and bran are fed, with the addition of cornstalks during a considerable part of the time. Turnips are raised largely for food, chiefly the white or "cowhorn" variety, and are highly

valued as an auxiliary during winter, giving the cows a good appetite, and thus aiding to keep them in good condition. They are especially nutritious when fed with meal or other ground food. One hundred bushels of turnips are considered a full supply for one animal during the winter. In the same season the quantity of brewers' grains fed to each cow in milk amounts to about six bushels.

The majority of those who stock heavily with cows purchase city manure in addition to that made on the farm. Under a prevailing system of liberal dairy management, the land is annually increasing in value, and it is estimated that the crop production is now double the yield of the same land twenty-five years ago. There are between 3,000 and 4,000 cows in the two counties, costing, when purchased, from $75 to $100 each. An estimate for the entire season puts the average yield per cow at eight quarts daily. The average price obtained for the milk at the farmer's door is 5½ cents a quart. The gross income from milk ranges from $125 to $200 per cow per annum.

Supply of milk by railroad.—The following information is furnished to the Department by Mr. R. Rockwell, of Colebrook, Connecticut: During the month of January, 1870, 1,400 quarts of milk per day were sent from Colebrook to the city of New York. The farmers received 6 cents per quart, delivered at the Winsted depot, distant one hundred and twenty-one miles from New York by rail. The freight from Winsted to New York was 1½ cents per quart, and the commission paid in New York was one-half cent per quart. The milk was sold to dealers in that city at 8 cents per quart. The quantity sent in the early part of June was about 1,000 quarts per day, delivered at the Winsted depot at 2¾ cents per quart. The average price at that point, for the year ending April 1, 1870, was 4½ cents per quart. For the same period the average receipts for the product of each cow of different dairies ranged from $60 to $120. Mr. Rockwell's dairy of 12 cows averaged $116 81 per cow. A cheese factory has just been completed at Colebrook, with facilities for manufacturing the milk of about 500 cows. This enterprise will probably lessen the quantity of milk sent to New York from Colebrook.

In a letter to the Department, dated July 20, 1870, Mr. E. S. Woodford, of West Winsted, states that at that depot farmers were then receiving 3½ cents a quart for milk.

A correspondent of the Department in Berkshire County, Massachusetts, writes that the number of cows in that county has increased, and that the sending of milk to market is a profitable business, much more so than its manufacture into butter and cheese. Mr. J. Z. Goodrich, of Stockbridge, in the same county, in a letter addressed to the farmers of his section, states that during the season of 1869, and even during the summer months, milk was carried every day on the Housatonic Railroad from Dalton and Pittsfield to New York City, a distance of about one hundred and seventy miles. It was brought to the station in the afternoon, and delivered in New York the next morning, in good condition, and in time to be served to customers before breakfast. The milk train of the Housatonic Railroad commenced running October 1, 1867, carrying 44 cans of 40 quarts each. The number increased to about 230 cans per day in 1868, and to 390 in 1869. Mr. Goodrich adds that the demand is yearly increasing. In his opinion the business will improve the farming lands of that section more than any other agricultural specialty; and he thinks the county ought to raise its milk production to 40,000 quarts daily within three years. As an illustration of the tendency of this business to enhance the value of land, one farmer on the Housatonic Railroad acknowledges that it has already added $3,000 to the value of

his farm. Mr. Goodrich estimates that it has added $20,000,000 to the value of farms on the Harlem Railroad.

Mr. Eli Smith, of Sheffield, Massachusetts, informs us that, next to West Cornwall, Connecticut, Sheffield is the most important milk station in the Housatonic Valley. When the milk train commenced running on the Housatonic Railroad, in October, 1867, this station sent only four cans per day. During the year ending November 30, 1870, it forwarded to New York 25,177 cans, of 40 quarts each, amounting to 251,770 gallons. The month of largest shipment was May, during which 28,730 gallons were forwarded; the quantity declining in November to 17,260 gallons. The business, which is gradually increasing, returns to producers from 3 to 4½ cents per quart in summer, and from 5 to 6 cents in winter. Sheffield is one hundred and thirty-six miles distant from New York by rail. The station of West Cornwall, Connecticut, one hundred and eighteen miles from New York, during the year ending November 30, 1870, sent to market 265,450 gallons of milk.

Milk supply of St. Louis.—It might be supposed that the market afforded for the sale of milk by the wants of a large city, or even a flourishing town, would soon produce in the surrounding country a corresponding competition for its supply, especially where the conditions of farming are well adapted to milk production. This, however, is not always so, even in localities of superior agricultural development, as is shown in the difficulty experienced by the citizens of St. Louis in obtaining a sufficient supply of milk. In January, 1870, Mr. C. W. Murtfeldt, secretary of the Missouri State Board of Agriculture, stated that, at that time, the city received no supply of milk by railroad, while at his residence at Kirkwood, fourteen miles from St. Louis, on the Pacific Railroad, "not a quart of milk is furnished for less than 10 cents, and even at that price people do not expect to get it *pure*. The night's milk is skimmed and mixed with the morning's milking, which is probably the nearest to pure milk which any of them get." In a letter to the Department, dated September 24, 1870, Mr. Murtfeldt states that two associations have been formed for the purpose of sending milk to St. Louis—one in St. Charles and Warren Counties, and the other in St. Louis and Franklin Counties. He adds that the retail price of milk in St. Louis in summer and winter is 10 cents a quart.

In St. Louis and its immediate vicinity there are, in round numbers, 150 milk dairies, 50 per cent. of these being within the city limits, and the remainder being situated from one to two miles beyond its boundaries. The smallest of these dairies keep not more than five cows each. The largest is that of Leser & Co., embracing 640 to 840 cows, according to the season of the year. The animals of this dairy are well fed, supplied with good water, and suitably lodged. In many of the small dairies the cows are crowded into dilapidated and filthy sheds. In all the dairies the stock is native and of inferior quality, values ranging from $25 to $80 per head—few animals bringing the latter price. In a large portion of the dairies, distillers' slops, at 10 cents a barrel, and malt, at 6 cents a bushel, are almost exclusively fed, a little hay being occasionally given. A gentleman of prominence in the dairy business states that in the St. Louis dairies the mortality among cows frequently amounts to 12 per cent. of the whole number annually, mainly resulting from close confinement, imperfect and filthy shelter, impure water, and inferior food. The milk sold is generally free from adulteration, using the term in its common acceptation.

BUTTER-MAKING WEST OF THE MISSISSIPPI.

In the early part of the year 1870, at a meeting of the St. Louis Farmers' Club, Mr. Murtfeldt stated that, while the grocery stores of the vicinity were placarded with advertisements of Ohio, New York, and sometimes Rock River butter, no mention was made of Missouri butter. Yet excellent butter is made by individuals in Eastern Missouri. In St. Louis, with hay at $20 per ton, and bran and meal at average prices, the keeping of a cow amounts to $90 a year, while on a farm with good pasture it would probably not amount to one-half that sum.

Mr. Hedges stated before the same club that the wife of one of its members makes butter that would sell in the St. Louis market for Goshen butter; yet, said he, "farmers here are killing their calves, and selling their hay, and it is a losing business. Yet this section presents excellent facilities for raising good dairy stock, as well as beef cattle."

Mr. A. M. Swan, of Oregon, Holt County, Missouri, in a pamphlet describing the resources of that county, says: "At this writing, poor country made butter, some of it half lard, is selling at 40 cents per pound, and is difficult to obtain even at that exorbitant rate." He remarks that dairy farming would be very profitable there, but that little land has yet been brought into tame pasture. Holt County has the Missouri River for its western boundary, and is traversed by the Council Bluffs and St. Joseph Railroad. The thriving city of St. Joseph, distant about forty miles by rail from the center of the county, affords an excellent market for all kinds of agricultural products.

Mr. T. T. Turner, a breeder of dairy stock near St. Louis, writing to the Department in September, 1870, states that he knows of no organized butter dairy within St. Louis County, the only home supply coming from farmers who manufacture in small quantities for individual customers. The market supply is chiefly derived from Ohio and New York. Throughout the year the price of good fresh butter averages 40 cents a pound, extra qualities bringing more. The Missouri cheese market is supplied from the products of Eastern States. Undoubtedly cheese and butter manufacture in Missouri, if conducted on a large scale and sustained by capital, experience, and skill, would prove very remunerative.

Mr. Turner writes that the introduction of improved dairy stock into Missouri is of comparatively recent date. Prior to 1865, a few Jerseys, and perhaps a few Ayrshires, were owned and bred by small farmers in the vicinity of St. Louis, but as late as the close of the war the general sentiment among Missouri farmers was adverse to the purchase of improved stock for dairy purposes. In St. Louis County, since that period, the demand for Jerseys has materially increased, although in the State at large it is doubtful whether remunerative sales of this stock could be made to any extent. The demand for such stock is chiefly from gentlemen of means residing near the city who desire superior cows, and are willing to pay good prices to obtain them. While purchasers of this class have readily paid for grade Jerseys at auction sales prices ranging from $100 to $200 each, according to the grades, farmers, on the contrary, have been disposed to sneer at such "fancy cattle." As far as Mr. Turner's experience goes, the demand for Ayrshires at fair prices is very small.

In an address before the Ohio Dairymen's Association, at Wellington, Ohio, in January, 1870, Mr. George Williams, of Oneida County, New York, stated that one of the most successful dairymen of Herkimer County, who bred stock to supply the waste of his herd, has found that not more than two in five of his calves prove sufficiently valuable for the dairy to

warrant their retention. Mr. Williams's own experience in raising Short-horn grades—a favorite stock with New York dairymen—has been scarcely more favorable, and has involved much loss. This want of success he attributes to the tendency of the Short-horn to beef. Notwithstanding the preference given by many to animals of this stock on account of the ease with which they are fattened when declining in milk, he is of the opinion that this advantage is more than counterbalanced by inferiority in yield during their milking period, when compared with Ayrshires, of which latter it is said that four in five of their heifers will prove profitable milkers.

CHEESE MANUFACTURE IN THE SOUTH.

In the report for 1869, page 356, some new facts were presented relative to cheese manufacture in the mountainous sections of North Carolina. At the State Fair, held at Raleigh, North Carolina, in October, 1870, Mr. William S. Cornell, of the Elk Mountain Factory, in calling attention to the great inducements which these sections offer to dairy enterprise, stated that they produce all the valuable grasses in luxuriant growth, are favored with an abundance of cool water, and, at elevations of 3,000 feet or more, possess a climate unsurpassed on the continent. At these altitudes, cows are not tormented in the warm season by flies; the night air is so cool and the water of so good quality that no ice is required to keep the evening's milk until morning; and the temperature of the day is sufficiently low to enable the manufacturer to work his cheese as slowly as he desires. Mr. Cornell states that while bluegrass and white clover make good milk, he has found, by experiment, that orchard grass will produce much more cheese than any other variety with which he is acquainted, and he therefore strongly recommends seeding pastures with this grass.

The following is the method of manufacturing cheese at the Elk Mountain Factory: When the milk is received at night it is placed in the vat; the agitator is put in motion, and water sufficiently cool to bring the milk to a temperature of 62°, or less, is kept running about it all night. When the milk of the following morning is added, the whole is again agitated a short time, to dissipate the animal odor; it then receives a supply of coloring matter, is heated to 82°, and is treated with rennet in sufficient quantity to induce signs of coagulation in fifteen minutes, the surface being kept slightly agitated until about the time of thickening. As soon as any whey makes its appearance around the edge of the vat, the curd is cut with great care to avoid bruising, and, after it has settled sufficiently for the whey to cover it, it is heated slowly to a temperature of 88° or 90°. It is then cut again very fine, and heated to a temperature of 98° or 100°, at which it is kept until sufficiently cooked. This may be determined by tightly pressing a handful of the curd and suddenly opening the hand, when, if thoroughly cooked, it falls apart. The curd is then gradually cooled, until it becomes sufficiently acid, when it receives one pound of salt to every forty pounds of curd; is put in hoops and pressed for several hours; then bandaged and again pressed for several hours. The cheese is then carried to the dry-house, where it is immediately oiled with whey butter, and left to ripen.

In a statement of later date, Mr. Cornell says that the factories of his neighborhood make a cheese of different quality from the New York manufacture, which is too mild for the Carolina trade, bringing 5 cents less per pound than the product of the home factories. The latter have been laboring under the disadvantage of a poor milking stock, and to

remedy this the Elk Mountain Factory proposes to procure a lot of cows from the North.

DAIRYING IN OHIO.

At the Ohio agricultural convention in January, 1870, Mr. C. W. Horr, of Wellington, a cheese manufacturer, stated that, during the past four years, cows supplying milk to butter and cheese factories in that section had averaged to their owners an annual return of $50 per cow, the average of some of the best dairies being quite $60 per cow. Mr. W. W. Wells, of Huntington, who keeps thirty-three cows on a farm of 200 acres, received in 1868, as the proceeds of his butter, after deducting charges for making and boxing, $2,100; and in 1869, a little over $2,300. He has expended $200 yearly for labor, and $100 in keeping his stock. This would make the average net proceeds of his herd $1,900 a year, or $57 58 for each cow. No allowance is made in this estimate for assistance in milking given by his wife and one boy. Mr. Horr stated that the assistant assessor of his district had informed him that nine-tenths of the income tax collected from farmers in the district were paid by dairymen, although they do not occupy one-half of the land.

DAIRYING IN THE NORTHWEST.

The dairy business in the States of Illinois, Michigan, Wisconsin, Iowa, and Minnesota is steadily increasing. No more favorable field is open to the enterprising dairyman. Partial statistics for these States for 1869 and 1870 present the following favorable results:

Illinois.—Elgin, in Kane County, is the center of one of the leading dairy districts of this State. It is estimated that there are 9,000 cows within a radius of ten miles from the city. During 1870 there were produced in this district and marketed, or made into butter and cheese, as far as returns have been received, a grand total of 3,462,715 gallons of milk. There were manufactured 1,697,705 pounds of factory cheese. At the Elgin condensing factory, 376,106 gallons of milk were condensed and shipped to New York. At the Elgin butter factory, 19,560 pounds of butter were manufactured, besides over 30,000 pounds of cream and skim cheese. Exclusive of the butter made at this factory, 350,000 pounds of butter passed through the hands of Elgin merchants. The total increase in the milk, butter, and cheese production of the district over that of any former year was 25 per cent. Elgin shipped to Chicago 480,000 gallons of milk; Algonquin, 236,000 gallons; and Dundee, 684,152 gallons. Dundee also shipped 42,980 pounds of cheese. Clintonville shipped 6,515 gallons of milk and 600,790 pounds of cheese.

The Chicago, Burlington and Quincy Railway carried to Chicago, during 1870, from ten stations, 683,680 gallons of milk.

The manufacture of cheese by the factory system is a far more prominent branch of the dairy business of Illinois than the manufacture of butter or the sale of milk. The following additional statistics of this branch, for 1869 and 1870, will make apparent the magnitude of this interest in a State that has until recently given but little attention to dairying:

Kane County: the total quantity of cheese made in 1869 was 3,920,750 pounds, which sold for $548,005; in 1870 there were a number of new factories started. McHenry County: the total quantity of cheese made in 1869 was 3,475,000 pounds, which sold for $486,500; many new factories were started in 1870, and the old factories increased the number of their cows. De Kalb County has increased the number of cows and cheese factories during 1870; in 1869, 2,113,800 pounds of cheese were

made, and $223,500 were realized. In Cook County, in 1869, there were 1,710.000 pounds of cheese made, which sold for $180,000; this county has fifteen factories, and 3,600 cows supply them with milk. Du Page County has seven factories, which made 1,092,500 pounds in 1869, selling for $115.000. Boone County: product of 1869, 807,500 pounds, which sold for $85,000; in 1870 there was a large increase of dairy products; there are seven factories, supplied by 2,200 cows. Winnebago County: product of 1869, 439,275 pounds, which sold for $16,250; in 1870 the factories were doubled and the number of cows greatly increased. Kankakee County, in 1869, had ten factories, and made 878,750 pounds, which sold for $92,500; in 1870 the number of factories was increased to sixteen. Lake County had seventeen factories in 1869, and made 1,562,125 pounds, which sold for $177,759; number of cows, 3,255; in 1870 the number of factories was increased to twenty. In Will County there were ten factories in 1869; number of cows, 2,500; product, 1,187,510 pounds; net receipts, $166,251 40; since 1869 farmers in this county have engaged more largely in dairying. The total number of cows in the dairy section of Illinois, in 1869, attached to cheese factories, was 36,180; capital invested in cows, $1,680,250; pounds of cheese made, 17,280,500, which, at an average of 14 cents per pound, sold for $2,419,279. The cheese product of 1870 does not much exceed that of 1869, owing to the drought in the early part of the former year. The average quantity of cheese made by each cow in 1869 was 475 pounds; average in 1870, about 425 pounds.

Wisconsin.—The manufacture of cheese is increasing in this State with great rapidity. In 1869 there were seventy-nine factories in operation; in 1870 this number was increased to one hundred and twenty-nine, and many cows were added. In 1869 the milk of 13,200 cows was used; value of cows, at $45 each, $594,000; quantity of cheese made, 6,270,000 pounds; net receipts, $877,800.

Michigan.—The manufacture of cheese is increasing in this State; also the manufacture of butter by the factory system. Statistics are wanting, but substantial progress was undoubtedly made in 1869 and 1870.

Iowa.—Mr. N. Eldred, of Iowa Falls, reports as follows: "Iowa produces very little cheese, probably not more than one-tenth the quantity consumed in the State. Interest in the business of dairying is being awakened, and I think it safe to predict that double the quantity of cheese now produced will be made two years hence. The cheese is made in the northern half of the State. There was a factory started in Wright County last season, one in Humboldt, two or three in Cerro Gordo, one in Jones, and my own in Hardin County; all on a small scale. My factory is perhaps a fair sample: whole number of cows, 100; ran four months; whole number of pounds of cheese, 21,000; sold at home at 15 cents per pound."

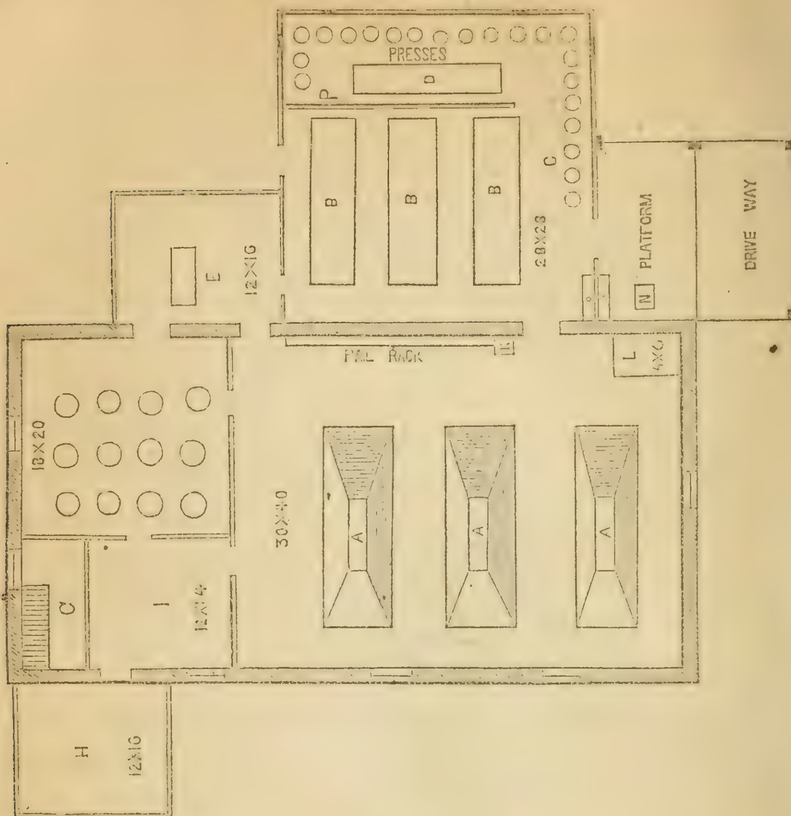
Minnesota.—This State has now a large number of factories. Bowen Brothers have one at Randolph, Dakota County, that uses the milk of 500 cows. In 1870 there were about twenty-five factories in operation.

The number and product of cheese factories in Indiana were increased in 1870 sufficient to supply the home consumption of the State.

Mr. I. H. Wanzer, of Elgin, Illinois, has established a cheese factory at Cameron, Missouri, with fair prospects of success.

Prize design for a butter and cheese factory.—The Northwestern Dairymen's Association has awarded a prize to Mr. M. H. Thompson, of Elgin, Illinois, for a design of a butter and cheese factory. The plan, a drawing of which is presented herewith, makes the measurement of the main building 30 by 60 feet; wing, or manufacturing room, 28 by 28 feet, one

story high; ice-house, 12 by 16 feet, with butter cellar underneath; engine-room, 12 by 16 feet. The cheese-room (wing) is built 3 feet below

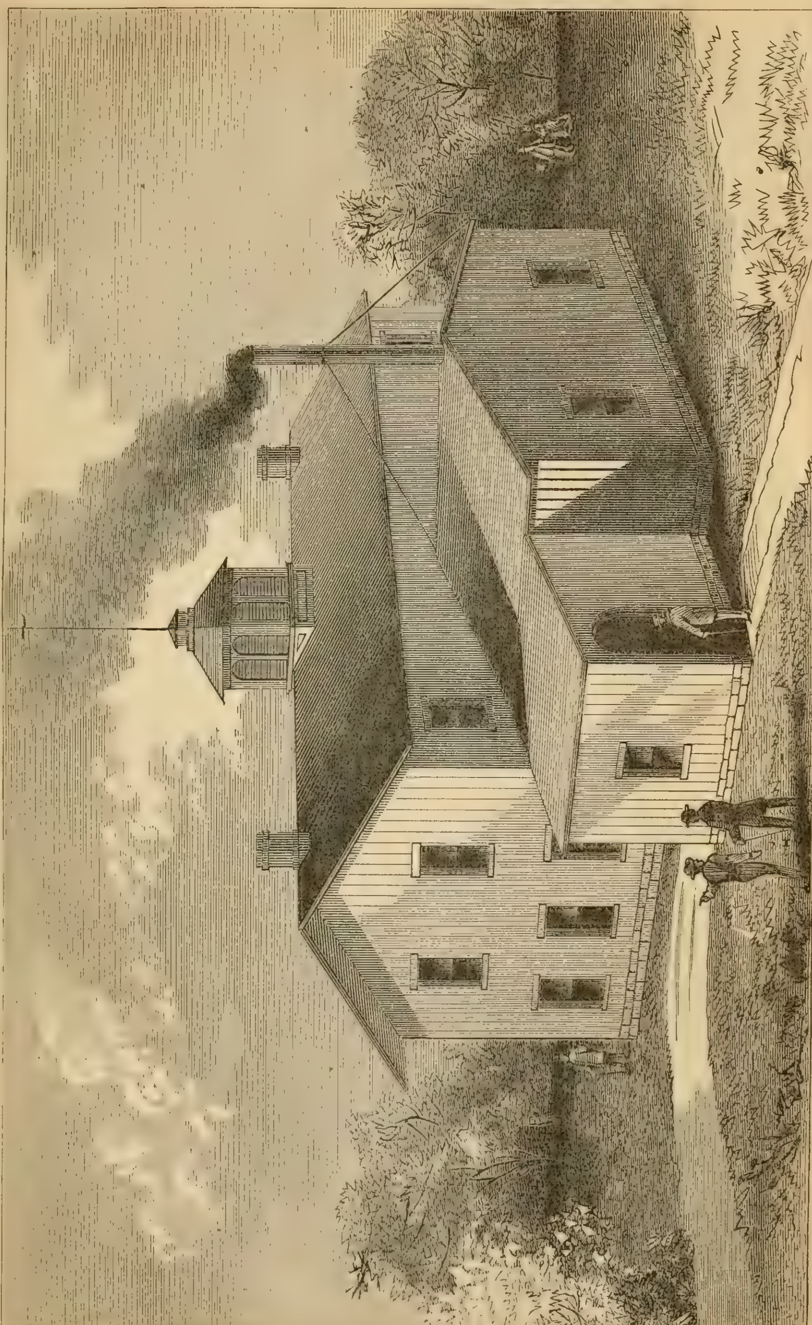


the level of the main building, that the milk may be conducted instead of carried. If intended for winter use, the first story must be of stone, with walls 18 inches thick. The partitions should be of brick. The cost is estimated, upon the basis of freight and material in Fox River Valley, as follows: masonry, $500; superstructure, $2,200; equipment, $1,800; total, $4,500. The points of excellence claimed are compactness, capacity in proportion to cost, adaptability to any site, change of size without change of plan, and adaptation to either winter or summer work.

DAIRYING IN CALIFORNIA.

Favored by an equable climate, the dairy interest is rising to a prominent position in California, and promises to add largely to the wealth of the State at no distant day, both in meeting the demand for home consumption and in the increase of exports. The counties of Lake, Sonoma, Marin, San Mateo, Santa Cruz, Santa Clara, Monterey, and San Luis Obispo, forming the central-coast section of California, constitute the chief dairy section of the State. The more northern counties of Mendocino and Humboldt, though perhaps equally well adapted to the dairy by soil and climate, are as yet scantily settled and poorly pro-

PLATE VII.



PRIZE DESIGN FOR BUTTER AND CHEESE FACTORY.

vided with market facilities. The eight counties above mentioned are reported to contain about 25,000 milch cows, distributed among dairy estates of widely varying magnitude. The largest dairy, that of Howard & Shafter, in Marin County, numbers between 3,000 and 4,000 cows. Steele Brothers, cheese manufacturers, own two herds of 700 cows each, one in San Mateo County, and the other in San Luis Obispo County. In Monterey County, Mr. S. C. Abbott owns 1,000 cows, a herd of excellent butter-making stock, chiefly of Devon, Short-horn, and Alderney blood, besides a large number of steers and young cattle. Other dairies number respectively 300, 400, and 600 cows. There are many important dairies in the interior, but, as a rule, that portion of the State suffers the disadvantages of greater summer heats and inferior pasturage. We give below some interesting facts in regard to the present condition of the dairy interest in California, derived from the statements of Mr. X. A. Willard, of New York, who visited that State during the summer of 1870, in company with other distinguished agriculturists from the East.

The dairy sections of the coast country possess a low, even temperature, with winters so mild that cattle need but little shelter, and are often wintered without other food than what they obtain from the fields. Even in these favored localities, however, the practice of good managers is to give a daily allowance of fodder in November and December, during the early part of the rainy season, at which time the old grass is injured by the washing of copious rains and the new growth is yet immature. After the close of December, green pasturage, embracing wild oats, the nutritious bunch grass, and other native grasses, is found in abundance until June or the beginning of July, when the dry season commences, which lasts until the latter part of October, and sometimes until December. During this dry season, the bunch grass and other wild herbage, though browned and crisped by the sun, afford a grateful nourishment to the stock, keeping it in high condition. The period from the beginning of January to June, in California dairy localities, corresponds to the best grazing season of the Atlantic slope.

On the 1st of August Mr. Willard visited the Howard and Shafter ranch, situated at Point Reyes, Marin County, near San Francisco, and claimed to be the largest butter dairy estate in the world. It has a coast range of fifty miles, and contains 75,000 acres, the surface of which is diversified by a succession of hills and valleys, varied occasionally by large level tracts. As an instance of the expenditures which have been made on the property, it is stated that, at the time of this visit, one hundred miles of fencing had been constructed, at a cost of $400 per mile, amounting to $40,000 for fences alone. The climate is cool, the temperature seldom rising above 65°, or sinking below 50°, the average for the year being about 60°. Stated in round numbers, there are 3,000 cows in milk on the estate, divided into twenty-one dairies. Improvement of milk stock was commenced in 1858 by crossing common eastern cows with two thorough-bred Short-horn bulls of a good milking family, brought from Vermont at a cost of $10,000. A year or two afterward, twenty-two head of Devon cattle were introduced, but did not prove satisfactory for dairy purposes, and were subsequently discarded. Since 1865 Short-horns have been the favorite stock, and the practice has been to raise annually one-fifth of the calves from the best cows, resulting in a good average product of milk at the present time. The animals are quite small, compared with the general standard of Short-horns, and are more active than usual for that breed, but were healthy and in excellent condition when seen. It is Mr. Willard's opinion that Ayrshires are better adapted to the locality.

With the exception of the "Home Ranche," the various divisions of the estate, with the cows and the necessary buildings, are let to tenants, generally at a rent rate of $30 per cow, tenants being required to raise one-fifth of the calves and to build or keep in repair certain fences, the owners providing the materials. Farm implements and dairy utensils are furnished by the tenants. The dairies average, for the season, a yield of about 180 pounds of butter per cow. Mr. Willard thus describes the butter-worker used by these dairies:

It consists of a heavy oak slab, of circular form, set at an inclination, so as to allow the buttermilk to pass off, and revolves on rollers arranged in a standard which supports it in the center. At the lower end of the machine, and just beyond the circular slab, there is an upright, at the top of which is fastened a metal socket for the reception of the lever used in working the butter. This socket works on a universal joint, so as to permit of its being moved in any direction. A plank, with grooves near the outer edges, is arranged below the circular slab, to catch the buttermilk and moisture flowing from the butter during the process of working, and is also slightly inclined, so that all slops pass off along the grooves and are deposited in a tub. By this arrangement the circular slab or bed of the butter-worker can be moved backward or forward on the plane of its circle, while the universal joint, to which the lever is attached, allows the lever to be handled in any direction. These butter-workers are the most convenient we have seen.

The butter is sent to San Francisco, and has a high reputation in that market, bringing, in rolls, 33 to 35 cents per pound, and in casks 30 and 33 cents, at wholesale. It is firm and waxy in texture, and the best specimens are of excellent quality, showing that, with the skillful management exhibited in the butter factories of Orange County, New York, the very finest product could be obtained. The low, even temperature, the softness and purity of the water, and the sweet and healthful food contribute to such a result in favoring the best condition of milk.

At the Muddy Hollow Dairy there were 166 cows in milk. The manager stated that, in flush of food, when cows were at their best, the average daily product of butter was one and one-fourth pound per cow. The texture was solid and waxy, the flavor fair, but wanting in the peculiar aroma of the finest grades of New York butter. The churning is done by horse-power.

The "Home Ranch" contains 3,000 acres, and on the farm, or connected with it, were 413 cows, 400 heifers—which were being raised for milk—158 horses, and about 2,000 beef-cattle. The beef-cattle are sent to market at the age of three years or more, and bring from $40 to $60 per head. Cows come in from December to March, in which latter month it is desired that they all be in milk. Here, as on the other farms, the bunch-grass, or grama, is depended upon for pasture, the hay consisting, as it does generally throughout the State, of oats, cut while the straw is green. About one hundred tons of this hay were harvested during the season, grown on fifty acres. Beets are raised in considerable quantities for cattle food, roots and tops being cut up together, and fed to cows in milk at the rate of a pailful each per day. On this ranch the cows receive occasional supplies of food as early as the month of August, according to the state of the weather, it being the intention to restrain the cows from ranging over the hills during the prevalence of chilling winds. Other dairies which were visited showed a product of butter averaging one-half pound daily per cow, the average in the flush of the season reaching one and one-quarter pound per cow. In summing up his observations, Mr. Willard points out the advantages which would result from division into smaller tenant farms, each supporting seventy or eighty cows, and

from the establishment of cheese and butter factories at convenient points.

Taking the presented data as the basis of an estimate, it would appear that the total butter product of the year at the Point Reyes estate reaches about 540,000 pounds, bearing a pecuniary value of $175,000.

A letter dated November 16, 1870, received by the Department from Mr. Shafter, one of the proprietors of the Point Reyes estate, states that this great dairy enterprise was commenced with a stock of Texas cattle, a large variety of grades being afterward purchased, and improvement persistently carried on by crosses with bulls of approved breeds. The stock of cows at the present time is estimated to be worth $45 per cow, average valuation. The estate comprises twenty-three organized dairies, and the intention is to increase this number, in 1871, to thirty dairies, with an aggregate of 4,500 cows. The butter is churned in box churns, measuring about 54 by 20 inches, and revolving forty-five times per minute on their longest diameter. The hands are not permitted to come in contact with the butter during any of the processes of manufacture and packing.

A correspondent of the Department in El Dorado County writes that, during the active season of 1870, 4,000 cows were employed in the dairy business in that county, and that the business is rapidly increasing. The mountain valleys afford green grass during the summer months, when the river valleys are dry.

In the San Francisco market, during the years 1867–'68–'69, wholesale rates of the best grades of State butter ranged from 70 cents in November and December to 35 cents at the close of May, when prices were at their minimum. Eastern butter is sold during the same period at much lower rates. During 1870 prices have been reduced by unusually large importations from the east, consequent upon the increased facilities of transportation afforded by the Pacific Railroad.

MANAGEMENT AND PROFIT OF FOWLS.

Except among professional poultry-breeders, and amateurs who can afford to gratify their fancy without regard to pecuniary remuneration, poultry has usually been left to care for itself to a great extent. The real profit of poultry-keeping is becoming better understood, however, and the care of fowls, in regard to both food and shelter, is increasing.

In the milder seasons of the year, domestic fowls, left to their own free ways, are almost invariably healthy. They secure exercise, pure air, pure water, variety of food, and access to fine dry soil in which to bathe. As health is the first condition of success in poultry-keeping, this fact presents the key to the whole matter, of profitable management of poultry on farms and in large numbers as a specialty. If fifty hens, kept in health, can be made to produce a clear annual profit of $50, a thousand in like condition may be made to yield a proportionate profit. The chief difficulty experienced is that of keeping large numbers in good condition, and this difficulty arises from failure to observe to the extent required the conditions which promote success with a few fowls. The proportion of range necessary, of sheltered space, of food, water, care, &c., must be extended mathematically in proportion to the number of fowls kept; and then, other things being equal, the profit is as certain with many hens as with a few.

Upon the farm, where a few fowls are kept for the benefit of the family, and have during much of the year free range, most of the conditions of moderate success are attained. With a little care and expense, however, absolutely necessary at some seasons of the year, better results may always be secured; and regular care is necessary from those who in cities or villages engage in poultry-keeping for pleasure or profit, hoping for success.

It is obvious that poultry must have room for exercise, and a place for rest, laying, and brooding, and such places should be fruitful, convenient, and healthfully located. The best soil upon which to keep poultry is a sandy one, resting upon gravel, as it retains the least moisture; stagnant moisture being a fruitful source of disease. Any soil upon which an inclosure for fowls is erected should be well drained. The place should have a southern or southeastern slope, preferably the former, and be sheltered from the north and east, thus securing warmth of the sun and of location, and security from cold winds. The hen-house should afford proper shelter and warmth; perches and nests should be kept clean and the air pure, without permitting any perceptible draught. The floor should be hard and perfectly dry, concrete or solidly packed earth being the best material. Whether composed of stone, brick, or wood, the house must be suited to the nature of its occupants. Success will be diminished in proportion to the neglect of any of these conditions.

A room eight to ten feet square is large enough for a roosting and laying house for twenty-five hens. If the walls are plastered, the protection against vermin and cold will be greater than when otherwise. The sunny side, except of the nest-room, should be composed of glass commencing one foot above the ground or floor, and if the glass is small there will be less liability of breakage by the fowls. The perches should be low, especially for the heavier breeds, unless there is convenient access to them by means of steps, so that the fowls may not injure themselves in jumping to the floor. A good arrangement is one in which one perch is elevated above the other and behind it, the perches being about two feet apart and the lower one two feet from the floor. Some prefer, however, not to furnish perches for Cochins and Brahmas, but to litter the floor with straw each night for them to rest upon. Perches for heavy fowls should be broad enough to give good support to the breast, or deformity of the breast-bone will ensue. The ground beneath should in all cases be strewed with sand or ashes, and removed often enough to prevent taint. Boxes for nests for sitting should be movable, for convenience of cleansing, secluded, and placed low. Many place the nests upon the ground. Chopped straw is a good material with which to fill nest-boxes, and should be clean. Where the fowls cannot have perfect freedom, it is necessary for their health that an inclosed yard should join the hen-house, to which they may have access. An eighth of an acre in grass is the proper proportion of land for twenty-five hens, but a smaller yard will answer if kept perfectly clean, and if a sufficient amount of vegetable food is supplied. Feed and water troughs or boxes of sufficient capacity should be provided, and so arranged for cleanliness and economy as to prevent the fowls from having access to them in any unnecessary way. If more than one breed of fowls are to be kept, the arrangements for their accommodation, above suggested, should be duplicated. If a smaller number, the proportions of house and yard may be diminished. These arrangements are such as are suggested and approved by the most experienced keepers, both in England and America.

Large numbers of fowls may be profitably kept by observing in due proportion the conditions of success with a few. They may be kept in large flocks, with extended conveniences, or divided into small flocks of fifty or less. It is reasonable to suppose that want of success with large numbers of birds is most frequently caused by neglect in the matter of cleanliness and food, causing disease, or low condition, destructive of profit, since it has been demonstrated by years of experience that thousands of fowls may be kept together with large and certain remuneration. The editor of the Massachusetts Ploughman, August 27, 1870, remarks that he has "frequently expressed the conviction that with proper management a large number of fowls will prove proportionately as profitable as a small number," and recommends in substance as follows: That an acre of land, at least, should be given to every two hundred fowls; wild, rocky land covered with bushes being as good as any; and that a flock of a thousand should have six acres. It should be fenced with boards or pickets, and houses should be erected, according to plans approved for smaller numbers, large enough to accommodate a hundred fowls with shelter, roosts, and nests. They should face the south, and the fronts should be partially or entirely glazed, the sashes opening on hinges at the top, so as to be opened in summer for free circulation of air. There should also be provided a number of low sheds about the grounds, beneath which the fowls may take shelter from the sun and storms. There should be abundance of pure water, easily accessible. Fowls selected for breeding should be kept separate from the others, in flocks of twenty, with the proper complement of male birds. This writer further says:

With a large flock properly kept on such a tract as we have described, there is no question as to its profits. The poulterer embarking in an enterprise of this kind should keep in view:

1. That the cheapest and most accessible land is the most desirable, always provided that a near and sure market is at command.
2. That the utmost economy consistent with the safety, comfort, and health of the poultry should be exercised in the erection of the buildings and fences.
3. That an abundance of pure water is accessible or attainable.
4. That fowls over three years old are not profitable, and a stock should be thoroughly renewed every two years.
5. That only the largest, hardiest, and best fowls should be used as breeders.
6. That a careful supervision of the flock is necessary, and that it enjoy the most perfect health and greatest comfort in summer and winter.

These suggestions accord with the conditions under which Mr. Warren Leland, of New York, has successfully raised, for many years, large numbers of fowls, securing abundance of eggs and poultry, principally for use in the Metropolitan Hotel in the city of New York. Mr. Leland's method with fowls is reported in the Transactions of the American Institute for 1868–'69; and from that work, and his letters to the Farmers' Club of that Institute and to this Department, we condense the following statement:

He devotes eighteen acres in one yard of his "Highland Farm," at Rye, New York, to his poultry, consisting of hens, ducks, turkeys, and geese. The broods have another large lot, and the turkeys have a half-mile range. The eighteen-acre lot is rough land, unsuited for tillage, having in it rocks, bushes, grass, weeds, and sandy places, and also a pond. It is supplied with heaps of ashes, bones, lime, and a portion is occasionally plowed to furnish worms. The fowls have woods and bushes to range in, the turkeys trees to roost in, and the ducks and geese enjoy the privileges of the pond. There are natural and artificial shelters for all, consisting of sheds, hillsides, bushes, nooks, and hiding places of all sorts for hens with broods, and trees are cut and bent

down into the grounds for shelter and roosts. The wings of none are clipped, and the hens may scratch and turkeys fly at pleasure within the limits of the grounds. After a trial of some years, Mr. Leland has discarded coops, finding that the greater freedom he allows the more healthful and profitable are his fowls. The principal features of his system are freedom, cleanliness, proper and sufficient food during the year, and change of cocks every spring. In summer, with the range they have, his fowls secure a good supply of animal food from the fields, in worms, grubs, bugs, grasshoppers, &c. They are also supplied at all seasons with the refuse scraps from the Metropolitan Hotel. Mr. Leland says: "Egg-making is no easy work, and hens will not do much of it without high feed. They need just what a man who works requires—wheat bread and meat." He feeds wheat, even when it costs $2 per bushel. No old nests are allowed. After each brood is hatched the boxes are taken out and whitewashed inside and out, and after lying in the sun and rain a few days they are half filled with clean straw and returned for use. The old straw is burned. Each of the 250 to 300 hens on hand in the spring is permitted to have one brood during the year. Four or five will have broods the same day, and to the hen which appears to be the best mother all the chicks are given. The others are given a cold bath and placed in confinement a few days, after which they return to the flock and their nests. Mr. Leland produces a great many eggs, which pay for food and attendance, and makes sales of poultry, amounting to several thousand dollars annually. If a hen comes off about the 1st of April with ten chickens, by the middle of June they will weigh twenty pounds and be worth $5. Mr. L. asserts that he can produce a thousand pounds of poultry cheaper than he can produce the same weight of mutton, beef, or pork. He finds as great profit from turkeys as from hens, and greater with more attention. One-year-old turkeys are found to be the best mothers, and gobblers of that age are also preferred. Three hatchings are put with one turkey in a large coop, half hidden in tall grass, as bare ground is fatal to the young. The chicks do not require food until the third day, when cracked wheat is given them. They require great care during the first two weeks, and must not be left out in the rain or wet, but after that age they grow without much care. After the season of grasshoppers they are fed on corn, and late in September they are ready for market. In the fall of 1868 Mr. Leland sold 450 turkeys, grown that year, for $1,752—nearly $4 each. He also sold 320 ducks for $352, and over 80 geese at $1 80 each. No food is given the geese after they have feathered; yet Mr. L. says other poultry is better and more profitable. He holds ducks—a cross between pure-bred Muscovy and English, which are hardy, finest for meat and best for eggs—in high esteem. The latter are fed on corn. His young chickens in 1868 numbered about 3,000, and his stock of all kinds of poultry about 4,000. It was estimated to be worth $4,000 in November of that year, when poultry was higher than it has since been. Mr. Leland prefers the large bronze turkeys, Poland geese, which lay earliest, and light Brahma hens. His cocks are of all kinds, as he finds excellent results from the crosses secured, and no old cocks are allowed on the place. When nine months old his early spring pullets begin to lay, and he gets 200 to 250 eggs daily during the cold season. He prefers the Brahmas because they mature early for spring chickens, are handsome, hardy, good layers, look well when dressed, and are of large size. No other hens are kept. The Black Spanish and White Leghorn have been found better for eggs, but they are undesirable for the table. He feeds corn, wheat, chopped

turnips, refuse cabbage, and the waste bread and meat scraps from his hotel, and sour milk from his farm; also burnt bones, lime, &c., for shell-making. During the past ten years Mr. L. has annually raised about 3,000 chickens, 450 turkeys, and 500 ducks and geese, and he thinks that the business might be made generally profitable, especially in rocky neighborhoods, and on a scale more extensive than his own. He says:

The great secret of my success is in keeping near the conditions of nature. At the outset I became convinced that, above all things, fowls must have space and cleanliness; that they cannot be expected to do well if confined in cramped and offensive quarters. With space and cleanliness, I cannot understand why the number need be limited.

He has never kept an account of his poultry business, being satisfied with its continuous success. He pays $250 per year and board to one man to attend his fowls, and buys about 200 bushels of grain each year, which, with the vegetables and refuse from his hotel, interest on land, and cost of buildings, make up the regular expenses.

The committee of the American Institute Farmers' Club, appointed to visit poultry yards and ascertain the best mode of wintering poultry, reported through its chairman, Mr. J. B. Lyman, that Mr. Leland had the best winter quarters for his hens, ducks, and geese, they had ever seen. The following description of his winter management of poultry is taken partly from the report of the committee, and in part from statements given by Mr. Leland. For the winter quarters of his flock—which at that season is reduced to 300 early spring pullets, 30 cocks, 30 turkeys, (sometimes many more,) and a few geese and ducks—he has a stone building 75 feet long and 25 feet wide, which faces the south. The openings on the north side are small and filled with window-glass, and in some cases with double sashes. Those on the south are much larger, consisting of double doors, which are opened on sunny days. In the middle of the north side is a wide old-fashioned fire-place. Nearly every day in winter a fire is kept up with chunks, knots, and logs that would otherwise be useless. The walls being of stone and the floor of earth or rock, the fire can be left without danger. The chimney can easily be closed, or the logs rolled out into the middle of the building, and feathers or sulphur be used for fumigation, which is done whenever hen-lice appear. Smoke is found to be better than carbolic acid, or kerosene, or whitewash, to drive away vermin. On cold and wet days the fowls gather before the fire, warm themselves and trim their feathers; and when the fire dies out they wallow in the warm ashes. Lime and plaster are freely used in the building to absorb odors and compost droppings. Roosts are made of oak slats an inch thick and two and one half inches wide, fastened to the rafters near the ridge. About two feet below the perches is a scaffold of boards that fit closely. This is covered with plaster and ashes from time to time, which, with the accumulated droppings of the hens, are frequently swept off, put into barrels with all refuse filth, and used upon corn land. The manure is valued at $1 per year from each hen, as the same amount of fertilizing salts in bone-dust which would cost $50 is annually saved from fifty hens. The wide perches used enable the hens to cover their feet entirely with their warm feathers, and prevent freezing in the coldest nights. The offal of the farm and refuse from the kitchen are thrown into this hen-house to be picked over; and besides this the poultry is fed about a bushel of corn per day in winter, and half a bushel in summer. Mr. Leland raises excellent crops of corn, having the best manure, and he feeds the product of four acres in keeping and fattening his poultry.

The use of fumigation for driving away vermin may be successful in a building such as we have described, but cannot be relied on as the best means under all circumstances. Whitewash for walls, perches, nests, &c., will always be found useful; and probably the best for protection against insects is that in which an ounce of carbolic acid is used with each four quarts of lime-water. This recipe, it is claimed, is certain death to parasites. A solution of one part of acid to sixty parts of warm water may be used then thoroughly wet with it on all parts of the body, and afterward as a wash for fowls, the mixture being cooled before use, and the fowls placed on dry, clean straw and dried in the sun. A soap for washing fowls, also, may be made by dissolving four pounds of common bar-soap in hot water, and adding one to two ounces of carbolic acid, according to the desired strength, and then letting it cool and become hard again.

COST AND PROFIT OF POULTRY-KEEPING.

The cost and profit of poultry-keeping on a large scale can only be approximately estimated from the preceding example, except as computed proportionately from more limited ventures. Small flocks, receiving special care more easily and punctually bestowed, are almost always found profitable, especially on farms and where little room can be devoted to their keeping in villages. The cost and profits vary, of course, with the conditions, such as the breed of poultry kept, care bestowed, suitability of quarters, and excellence and location of markets; so that reliably reported examples from various sources and localities will best demonstrate the utility of poultry-keeping.

Mr. Nelson Ritter, of Syracuse, New York, in the first three months of 1869 received eggs from fifty-six hens as follows: In January, 868; February, 891; March, 984; with fourteen of the hens sitting from about the middle of the month. The eggs were sold for $65 98; the expense of keeping was $26 13; the profit on eggs for the three months was $40 85. The hens were a cross of Brahmas with several other breeds.

A gentleman of Waverley, New Jersey, reports the account kept with twelve common yellow hens and one cock during January and February, 1870: Expenses, except for care, $3 25; receipts, 472 eggs, which sold for $15 02; profit, $11 17. His hens had a clean, warm house, with plenty of out-door range, and were well supplied with food, pounded oyster-shells, ashes, &c.

Mrs. E. A. Lawrence, of Brooklyn, New York, makes a statement of her account with ninety hens and eleven cocks for the year ending March 4, 1870. She sold and used 115 fowls, of the increase, and had 127 hens and 23 young chickens at the close of the year, and the eggs produced numbered 8,001. The total credit was $390 70; expenses, $182 21; leaving a profit of $208 49. The fowls were Brahma, White Leghorn, Bolton Gray, and some unnamed varieties, and they were allowed to mingle freely. The flock was well fed with wheat screenings, oats, buckwheat, rye, pork scraps, and potatoes boiled and mashed in bran, and in cold weather chopped cabbage was given. Mrs. L. derived most profit from eggs, which sold for prices averaging nearly 2¾ cents each, while the average price received for fowls was 79 cents.

Dr. I. P. Trimble, of Newark, New Jersey, kept for six months, ending July 1, 1870, an average of eighteen hens and two cocks. The fowls were kept in an inclosure 20 by 29 feet, were fed on corn, scraps from the house, and, for green food, clippings from the lawn and salad, which they relished very much. In the winter and spring they also had

the range of the garden. They produced in January 92 eggs; in February, 214; March, 251; April, 280; May, 216; June, 237; total, 1,290; which at market prices were worth $40 49. There were also thirty-two March chickens, worth, July 1, $8; making the value of the product $48 49. The cost of feed was $19 45, of which nearly $10 were for corn. Net profit for six months, $29 04, or $1 45 per fowl. It will be noted, however, that this account is for the best portion of the year.

G. T. S. reports to Hearth and Home the account of six months, commencing with January, 1870, with twenty-two hens and three cocks of the common sort. The number of eggs produced was 1,711, of which 48 were used for sitting, leaving 1,663, which at market prices were worth $41 57; the twenty-one chickens hatched were worth $10 50; making a total value of $52 07. Deducting $12 71, the cost of feed, the net profit is $39 36—over $1 57 for each fowl; or, as the report states, a net profit of $39 36 on a capital of $25 for six months. This statement, also, covers the best portion of the year for eggs.

Mr. Benjamin W. Palmer, of New London, Connecticut, who has made a business of poultry-keeping for many years, commenced and closed the year with one hundred and twenty fowls, and produced eggs which were sold each week as follows: In January, 408; February, 888; March, 1,428; April, 2,112; May, 2,172; June, 1,722; July, 1,770; August, 1,824; September, 1,044; October, 744; November, 252; December, 120; total, with 630 used in his family, 15,114—$361 80. The cost of feed, consisting of corn, rye, oats, buckwheat, meat, bones, &c., was $200, leaving a clear profit of $161 80—nearly $1 35 from each fowl—the manure, about fifty bushels, more than paying for marketing, care, and interest on investment. Mr. Palmer's stock consisted of the Brahma, White and Gray Leghorn, Black Spanish, and cross breeds. He feeds liberally, keeps clean quarters, and gives his hens their liberty, at least during afternoons in the summer, and for an hour or more at noon in winter.

Mr. A. F. Hitchcock, of Willink, New York, kept, in 1868, eight, and half of the time nine, hens and one cock, which produced 1,277 eggs, for which he received $26 81. The cost of food was $10 93, which leaves $15 88 profit. He fed coarse meal, dry in cold weather and wet with milk in summer; boiled potatoes, and occasionally meat in winter. Wood ashes and pounded bones were also given. The fowls were a mixed breed, Brahma blood predominating.

X. Y. Z., of Rochester, New York, states, in the Rural New Yorker, that he keeps an average of sixty-five fowls to supply his family with eggs and poultry; that in February, 1864, he commenced to keep an account of the number of eggs produced and fowls consumed and sold, and that in five years he gathered 34,859 eggs, nearly 7,000 annually, and 107 per annum for each fowl. He computes the food furnished as equal to one bushel of corn per fowl each year. If, however, the fowls used or sold, and the manure, which he utilized in his garden, paid for the keeping and other expenses—a reasonable supposition—the eggs were clear profit: and, at 30 cents per dozen, the product during the five years was $871 47, or $174 29 per annum, or $2 68 per year for each fowl. The varieties kept until 1867 were the Black Spanish, White Leghorn, and common mixed breeds, and after that time principally the light Brahma.

Another correspondent says that in December, January, and February, of 1866–'67, from twenty-two light Brahma pullets he got an average of sixteen eggs per day, and the net profit for the three months was $52.

Mr. Jonas Sawyer, of Berlin, Massachusetts, reported to the Farmers Club of that town his success with thirty-three fowls during the year

ending January 1, 1870. The total debit was \$79 44, and the credits, for eggs, poultry sold and eaten, and increase of fowls, amount to \$257 86; leaving a net gain of \$178 42—about \$5 40 for each fowl. The breeds were Brahma and Chittagong. They were allowed their liberty during the year, were well fed with corn and waste from the kitchen, and had broken bones, oyster shells, &c. Mr. Sawyer says: "There is more in the attention than the breed, although the latter is important. Kindness, gentleness, and familiarity will repay when bestowed on animals, and it is especially true when shown to fowls."

A gentleman, of Concord, Massachusetts, reports the profits on his hens from October 1, 1868, to October 1, 1869. He has fifty-four hens and three cocks; the cost of keeping was \$148 64, and the income from eggs, hens and chickens sold, and increase of stock at the end of the year, was \$240 77; leaving a balance of \$92 13, or about \$1 70 per hen. These fowls, mostly Brahma, were confined all the time in a close yard, but were well supplied with a variety of food.

T. G. L., of Taunton, Massachusetts, publishes an itemized account of his poultry for 1869. His stock consisted of 56 hens, 4 cocks, 10 hen-turkeys and 1 cock, 15 geese, and 25 pigeons, at the beginning of the year worth \$132 75. At the end the increased value of the stock on hand was \$20 75. The cost of feed and of 17 hens, 2 cocks, 24 chickens, 10 turkeys, and some eggs bought, amounted to \$467 75. He sold 2,641 pounds of poultry, 115 pounds of feathers, 364½ dozens of eggs, 10 Brahmas and 11 Bantams raised for fancy poultrymen, and received \$58 50 from the county for damage to his poultry by dogs; the total receipts, with the increased value of stock on hand at the end of the year, being \$1,146 07. Thirty dozens of eggs used in the house and fifty bushels of manure do not enter into the credit side of the account, nor half the sour milk from one cow and fifteen bushels of small potatoes into the debit side. The fowls were of Asiatic breeds, the turkeys bronze, and the geese Bremen.

Mr. F. W. Babcock, during 1869, kept twenty hens of Brahma, Black Spanish, and common breeds. They produced 1,751 eggs, as follows: In January, 75; February, 155; March, 210; April, 252; May, 159; June, 218; July, 95; August, 265; September, 188; October, 91; November, 43; December, none. The eggs, at 25 cents per dozen, were worth \$36 50. Forty pullets were also raised, the value of which is not stated.

The income from the hens of C. M., of Jefferson County, New York, is stated substantially as follows in the Rural New Yorker: In 1867 he kept twelve hens, and from January to October their products amounted to \$50 48. From November, 1867, to November, 1868, eleven hens were kept, except in the last two months, during which there were only nine, and the income from sales was \$38 34. No account is given of eggs or poultry used in the family, nor of cost of feed, &c. The house in which these hens were kept was 7 by 8 feet, having a yard 10 by 12. Free range was given also after 4 o'clock each afternoon during most of the summer. Mr. M. states that a hen will eat 90 pounds of grain and 5 pounds of meat, with worms, grass, milk, water, &c. at pleasure, during the year; and he seems to be fully convinced of the profitableness of poultry-keeping. His hens were cross breeds from various kinds, and his sales were made in Watertown, New York. It will be seen that his proceeds were large; in the first year over \$4 per hen, and in the last, \$3 83 each.

Mr. J. H. Severson, of Knowersville, New York, has kept fifteen to seventeen hens, of common breeds, during seven years, and gives the account of 1869 as an example of the whole time. His fowls have free range,

are fed twice a day, and have meat once a week in winter. In the year named he kept fifteen hens and one cock; sold 125 dozens eggs for \$38 75, used 28 dozens, worth \$7, and raised 28 chickens, worth \$7 80; total, \$53 55. They cost him, during the time, \$18 25, leaving a clear profit of \$35 30, or about \$2 20 each.

Mrs. Delia Devinny, of Denver, Colorado, kept an account with 140 hens and 14 cocks, from September 1, 1868, to September 1, 1869, and, including in her account the value of stock on hand at the commencement of each year, it foots up thus: Debtor, \$357 03; creditor, \$686 92; profit, \$329 89. She lost 500 early chickens by cold, damp weather; and, as she set many hens, she sold only 9,444 eggs. The profit in this case, notwithstanding the large loss of chickens, is \$2 14 for each of the 154 fowls. In 1868, when more attention was paid to producing eggs than raising chickens, these hens produced 132 eggs each. The stock was a mixture of various breeds.

A gentleman, of Fredonia, New York, kept an average of twenty-six fowls during 1869, at a clear profit of \$46 68, about \$1 80 each. His stock was mixed Dorking and Brahma, and had the run of a small barn and one-eighth of an acre of ground. They were fed wheat, wheat screenings, and corn-meal, with meal pudding once a week, and had plenty of water.

The San Francisco Scientific Press, of December 24, 1870, states that an industrious laborer took up some Government land near Marysville, California, built a cabin, and purchased chickens and turkeys of the value of \$100 for a stock to start with. His fowls nearly picked up their living, and at the end of eighteen months (covering the second spring and summer of his occupation) he had sold poultry and eggs to the amount of \$1,500 above the small cost of keeping, and had on hand stock five times the value and amount of the original.

Mr. Edwin Jones, of Otsego county, New York, published in the Rural New Yorker his account with poultry for the year 1869. His fowls were a mixed breed of Brahma, Hamburg, Seabright, and native. He fed oats, buckwheat, and wheat screenings. His account is presented in the following table, which furnishes a simple form that may be serviceable to others:

Month.	Number of hens.	Number of eggs laid.	Received for eggs sold.	Cash price eggs used.	Poultry sold and eaten.	Cost of feed.
January	23	145	\$3 21	\$0 27	....	\$3 10
February	23	362	5 62	1 28	....	2 80
March	23	342	5 94	1 29	....	3 10
April	23	421	5 67	1 38	....	3 00
May	22	380	4 49	1 78	\$6 10	2 87
June	15	207	2 53	1 25	....	2 00
July	14	179	2 56	46	1 20	......
August	13	196	2 73	50	75	......
September	13	153	2 06	69	1 50	......
October	13	90	1 20	67	1 00	......
November	13	45	1 05	20	1 00	2 00
December	23	124	2 83	43	70	3 00
Total	Av'g 18	2,644	39 89	10 20	12 25	21 87

Total receipts	\$62 34
Total expenses	21 87
Profit	40 47

The eggs were sold at an average price of 22¾ cents per dozen, and the profit from each fowl was about $2 21. Mr. Jones estimates that the benefit conferred by his hens in eating foul seeds, weeds, &c., with the value of their manure, more than equalled the cost of keeping.

Mr. Joseph Getchell, of Wells, Maine, kept twenty-two young hens and one cock of the Black Spanish breed, and two hen-turkeys, during the year 1868, and his receipts and expenses were as follows: 298¼ dozens eggs, which brought $80 60, and twenty-six young turkeys, which sold for $55; total receipts, $135 60. Cost of feed, $35 60; leaving a profit of $100. The expenses are not so given as to determine the proportion incurred by the hens; but supposing it to have been $1 each, making $23, the profit from their eggs would be $57 60, or $2 50 each. The hens were fed with corn, buckwheat, barley, and oats, three times each day, and allowed to go at large. In cold weather they had warm water, which is deemed important by Mr. Getchell. The turkeys, when the young were a few weeks old, were allowed to obtain their own food in the fields, until fattening time, when they were fed at a cost of $6, which amount is included in the foregoing statement.

The account of a lad in Yonkers, New York, extending from May, 1869, to May, 1870, shows his success with seven hens and one cock. He raised thirteen chickens, worth $10; secured 667 eggs, besides those set, worth $22—making $32. The cost of keeping was $15; leaving $17 profit, or $2 12 each.

The account current of Mr. John Buffington, of Salem, Massachusetts, with poultry during the year ending January 1, 1870, is as follows:

Stock, January 1, 1869, *cost of food, &c.*

38 fowls, at 75 cents, $28 50; 13 ducks, at 75 cents, $9 75	$38 25	
4 guinea fowls, $2; 20 chickens, $6	8 00	
		$46 25
42 bushels of corn, $46 60; 20 bushels of oats, $24 25	70 85	
24 bushels of meal, $25 95; 24 bushels of corn, $25 95	51 90	
36 bushels of shorts, $14 45; 2 bushels of barley, $3	17 45	
221 pounds of scraps, $3 66; squashes, $2 50	6 16	
Cayenne pepper, 50 cents; sulphur, 74 cents; rat exterminator, 25 cents	1 49	
34⅔ dozens hens' eggs set, at 39 cents per dozen	13 52	
18⅔ dozens ducks' eggs set, at 49 cents per dozen	9 15	
Other expenses, including labor on coop, dressing poultry, &c	23 57	
		194 09
Total		240 34

Stock, January 1, 1870, *sales, &c.*

32 hens, at 75 cents, $24; 12 ducks, 75 cents, $9	$33 00	
118 chicks sold, $71 24; 144 ducks, $96 43	167 67	
171$\frac{11}{12}$ dozen hens' eggs, $67 45; 15$\frac{2}{12}$ dozen ducks' eggs, $7 45	74 90	
28 barrels of manure, $29 75; feathers, $1	30 75	
62$\frac{3}{12}$ dozens hens' eggs used in family, 39 cents	24 28	
5$\frac{7}{12}$ dozens ducks' eggs used in family, 49 cents	2 73	
		333 33
Profit		92 99

Mr. S. Mahler, of Batavia, New York, reports that he kept sixteen hens and one cock from April, 1869, to January, 1870, from which he realized a profit of $30 52, or $1 80 each. The Rural New Yorker gives the poultry account of a correspondent for the year 1869, as follows:

Dr.

To 55 hens and 11 cocks, at 50 cents	$33 00
To 2 cocks bought, at $1	2 00

To 5 cocks bought, at 75 cents	$3 75	
To 6 hens bought	5 00	
To 22 chickens bought	5 00	
To 1 dozen Brahma eggs (extra)	5 00	
To feed for the year	117 50	
		$171 25

CR.

By 86 dozens eggs sold, at 40 cents	$34 40	
By 50 dozens eggs sold, at 36 cents	18 00	
By 229 dozens eggs sold, at 30 cents	68 70	
By 97 dozens eggs sold and used, at 25 cents	24 25	
By 8 cocks sold, at $1	8 00	
By 12 cocks sold, at 75 cents	9 00	
By 80 hens and pullets sold, at 75 cents	60 00	
By 35 other fowls sold	13 50	
By fowls on hand	40 00	
		275 85
Profit		104 60

The fowls in this case were mostly Brahmas, a few being crosses of that breed and Black Spanish.

Mr. S. S. Cook, of Franklin, Massachusetts, presents in the New England Farmer his account with twenty-five hens kept during 1869, as follows:

DR.

January 1, 1869.—To value of 25 hens	$25 00	
To food for hens and chickens	80 90	
		$105 90

CR.

December 26, 1869.—By 25 large hens	$25 00	
By 15 small hens, or pullets	15 00	
By 155 dozens eggs, at 35 cents	54 25	
By dressed poultry sold	111 50	
		205 75
Profit		99 85

The profit from each fowl was $3 99⅖. Brahmas and Leghorns were kept. No account is made in these reports of the care of fowls on the debit side, nor of the value of manure or feathers on the credit side.

In Flint's "Agriculture of Massachusetts" for 1869 several accounts with poultry are given by citizens of that State, which are briefly as follows: George W. Chadwick kept eight Brahma and Hamburg hens and one cock one year. They yielded in eggs and chickens the value of $42 90, and their feed cost $24; leaving a profit of $18 90, or $2 10 each. The profit on fourteen hens and cocks, a cross of White Leghorn and native breeds, kept by S. B. Bird from March 20 to September 20, was $62 75. The profit on twenty-four hens, mostly White Leghorns, kept by Lewis Jones from January 1 to September 1, 1868, was $88 92, or $3 70 each.

The Mirror and Farmer records that fourteen Red Leghorn hens kept by Mr. Eben Fellows, of Franklin, New Hampshire, laid 2,314 eggs from March 23, 1869, to March 23, 1870, which sold for $53 92. Six broods of chickens raised in the year paid the cost of keeping the poultry.

Mr. Benjamin V. Brown, of Concord, Massachusetts, sends to the Department his account with poultry during 1869. His hens were a cross between the Brahma and White Dorking. Nothing is charged for care,

as, he says, "the manure, and eggs used by the family, would a great deal more than pay for the care." The account is as follows:

Dr.

To 45 fowls, at 75 cents	$33 75	
To 1 turkey	1 25	
To corn, oats, &c	62 00	
To meal and scraps	11 95	
To potatoes and meat	4 50	
		$113 45

Cr.

By poultry sold	$111 27	
By eggs sold	64 56	
By 40 fowls on hand, at 75 cents	30 00	
By 2 turkeys on hand, at $1 25	2 50	
		208 33
Profit		94 88

The profit of turkey-keeping, in the vicinity or within easy access of good markets, is frequently greater than that with chickens, but fewer examples have been published. Mr. W. A. Browning, of Connecticut, gives to Hearth and Home his account with eight hen-turkeys and one cock-turkey during 1869. He raised 112 young turkeys, which were disposed of as follows:

Sold at Thanksgiving 29, weight 348¾ pounds, at 27 cents	$94 16	
Sold at Christmas 71, weight 1,072 pounds, at 25 cents	268 00	
On hand January 1, 1870, 12, worth $2 each	24 00	
		$386 16
Up to June 1, fed 8 bushels corn, worth $1 20	$9 60	
Up to July 1, fed 4 bushels corn, worth $1 20	4 80	
Up to August 1, fed 6 bushels corn, worth $1 20	7 20	
Up to September 1, fed 10 bushels corn, worth $1 20	12 00	
Up to October 1, fed 20 bushels corn, worth $1 20	24 00	
Up to November 1, fed 35 bushels corn, worth $1 20	42 00	
Up to December 1, fed 35 bushels corn, worth $1 20	42 00	
		141 60
Profit		244 56

The Country Gentleman publishes an account of the treatment of and profit from sixty-five hens and five cocks kept by a gentleman in Boston, New York, most of the fowls being Brown Leghorns. They were fed twice a day—in the morning, in winter, with beef scraps and meal, mixed with boiling water and allowed to cool, and in the afternoon with whole corn. Their feed was always of the best quality, and ground oyster shells were always before them. From January 1, 1869, to January 1, 1870, there was expended for feed for the seventy fowls, $157 44, and received for eggs and fowls sold and used $360 57, leaving a profit of $203 13; or $2 90 for each fowl. In January, 1870, the sixty-five hens produced 950 eggs, and in February 1,099, and the cost for feed during the time was little more than $13, or about 8 cents per dozen of eggs.

Mr. J. W. Todd, of Vermillion, Ohio, reported to the Farmers' Club of the American Institute the result of his experience during 1868 with fifty-six hens and four cocks, consisting of White Leghorn and Brahma. His statement is as follows: 615 dozens eggs, at 29 cents per dozen, $178 35; cost of feed, $30; profit on eggs, $148 35. From the same hens he also raised 198 chickens, which sold for $180 95; expenses, $80: profit on chickens, $100 95. Total net profits, $249 30. This is a profit of $4 15½ on each fowl. The same flock produced from January 1 to April

20, 1869, (110 days,) 480 dozens eggs, which at 25 cents per dozen amounted to $120. The cost of feed during the time was $20, leaving a profit of $100. The fowls were well fed with a variety of food, and had the best of care. In summer they ranged freely, and in winter they were divided into two or three lots and kept warm in a roomy building. Mr. Todd remarks that "there is much in feed as well as breed," a truism which is applicable to all farm-stock.

The profits of poultry-keeping, as shown in the preceding examples, are very great, and will appear surprising to those who have given no thought or attention to the business. Hens have been kept so long upon most farms as a matter of course and their products appropriated so generally without credit, that their real value under careful and intelligent treatment is seldom duly considered. Objection may be made that no account is taken of the refuse of the kitchen and gleanings of the farm. It is true that these sources of food supply are valuable, and it is equally certain that they would otherwise be wasted in a large measure.

As an item of property, poultry has escaped attention in national and State enumerations, except in the census of the State of New York for 1865, in which the value of live poultry on hand at the date of taking that census, and the value of eggs and poultry sold in 1864, are given separately. The value of the poultry owned was $1,858,797 97. The value of poultry sold was $1,228,043 96, most of which, undoubtedly, was for market fowls. The value of eggs sold was $1,303,010 07; making the value of eggs and poultry sold, $2,531,054 03.

The cases reported above may be those of exceptional success. They certainly present the profit of poultry in a favorable light. Nineteen examples, in which the record includes a full year, each representing from 8 to 154 fowls, together aggregating 720, present a gross return of $2,013 59, or $2 80 for each fowl, of which a good proportion is profit, though the facts are not in every case so fully stated as to admit of an exact calculation of net profit.

THE MOST POPULAR BREEDS.

The profits of poultry-keeping being derived principally from two sources—the sale of eggs and of poultry, mostly chickens, in market, the question of breed is an important one. For eggs, it would seem that, with proper attention and care, the non-sitters are preferable; but some of the varieties of non-sitters are not hardy, and the extra attention such fowls require may be greater in cost than the enhanced value of their production. Fowls have been classified, not only in respect to their qualities of flesh and as layers, but also with a view to other characteristics. The following classification, based on the statement of an experienced poultry firm in New York, is approved by Tegetmeier:

1. HARDINESS.—*Hardy:* Brahmas, Houdans, Hamburgs, Crèvecœurs, Spanish, and Leghorns. *Delicate:* La Flèche, Polands, and Bantams.

2. QUIETUDE.—*Domestic and quiet:* Brahmas and Cochins. *More vivacious:* Spanish, Leghorns, and Dorkings. *Active:* Hamburgs and Games.

3. SIZE OF BIRDS.—*Large:* Brahmas, Cochins, La Flèche, Houdans, Crèvecœurs, and Dorkings. *Medium:* Polands, Spanish, Leghorns, and Games. *Small:* Hamburgs and Sultans. *Diminutive:* Bantams and Silkies.

4. SIZE OF EGGS.—*Layers of large eggs*, averaging about 7 to a pound: La Flèche, Houdans, Crèvecœurs, and Black Spanish. *Layers of medium eggs*, averaging 8 to 9 to a pound: Leghorns, Cochins, Brahmas, Polands, Dorkings, Games, and Sultans. *Layers of small eggs*, averaging 9 to 10 to a pound: Hamburgs.

5. NUMBER OF EGGS.—*Great layers:* Hamburgs, Spanish, Leghorns, and Polands.

6. INCUBATION.—*Good sitters:* Cochins, Brahmas, Dorkings, and Games. *Non-sitters:* Houdans, Crèvecœurs, La Flèche, Spanish, Polands, Hamburgs, and Leghorns.

7. VALUABLE FOR FLESH.—*True table-birds:* La Flèche, Houdans, Crèvecœurs, and Dorkings. *Flesh less juicy:* Cochins and Brahmas.

In confirmation of the opinion expressed above, concerning the superior fecundity of the breeds named, the opinions of poultry breeders in various parts of the country, as recently expressed in communications to this Department, are annexed:

Mr. Samuel J. Parker, of Westchester, Pennsylvania, says: "Leghorn, Spanish, and Hamburg fowls will lay more eggs in a year than the larger and more hardy varieties, they being non-sitters."

Mr. O. B. Hadwin, of Worcester, Massachusetts, says: "Hamburgs, Games, Leghorns, Spanish, Dominique, Bantams, or medium-sized fowls, are the most prolific in eggs."

Mr. William M. Leonard, of Belmont, New Hampshire, vice-president of the Merrimack Valley Poultry Association, says: "I find the White Leghorns will lay more eggs in a year than any other breed of fowls."

Mr. J. S. Gould, of Ithaca, New York, expresses the opinion that the Leghorns are the best layers.

Mr. W. Rodman, of West Farms, New York, says: "There is little doubt that the Hamburgs, Silver-spangled and Black, are our best layers, they being most hardy."

Mr. Thomas Gould, of Aurora, New York, says: "I find none so good as the Hamburgs."

Mr. A. W. Sawyer, of Sycamore, Illinois, says: "I consider the White Leghorns the best summer layers, and the Light Brahmas the best winter layers."

Some, however, prefer the Brahmas to any other breed for eggs, and this preference is expressed, generally, in the examples of cost and profit of poultry-keeping in the preceding pages.

Mr. H. Bishop, of Springfield, Ohio, says: "I find full-blooded Light Brahmas the best for the production of eggs."

Mr. Benjamin V. Brown, of Concord, Massachusetts, says: "I am convinced, and it is the prevailing opinion in this vicinity, that Brahmapootras are best for the production of eggs."

Mr. L. A. Spalding, of Lockport, New York, says: "As egg-producers, the Brahmas are in the front rank, and commence to lay at six to seven months old; and my first lot of sixteen laid in one year an average of 140 eggs each." Mr. Spalding remarks that he finds no difficulty in breaking these fowls of the desire to sit.

Mr. Leavitt, of New York, prefers the Brahmas, both for eggs and flesh, as they are hardy and cost less to keep than the best so-called egg-producing breeds.

For market fowls the following is the testimony of the gentlemen just quoted:

Mr. Brown says: "It is an established fact that the Brahmas are the best for market, on account of their size and fine appearance when dressed."

Mr. Leonard: "I find the Brahmas the best fowls to raise for market."

Mr. J. S. Gould: "For market fowls the Brahmas or the Houdans are best; I am not quite sure which."

Mr. Rodman prefers Dorkings and their crosses for the table.

Mr. Thomas Gould: "For a table or market fowl I think the silver-gray Dorkings superior to any other breed."

Mr. Bishop, who raises chickens for market, says: "I find full-blooded Light Brahmas the best for market fowls."

Mr. Spalding: "For the table the Brahma has no superior."

Mr. Hadwin: "Brahmas, Dorkings, Javas, Cochins, with the larger native breeds and crosses, are the best flesh-producing fowls."

Mr. Sawyer writes:

> I think the Light Brahmas the best for market, for they are large fowls, are fine large chicks at four to six months old, are easily reared, and are very hardy, I think the most so of any variety I have ever raised. All things considered, the Light (pea-combed) Brahmas are the best fowls for the farmer to raise. They bear confinement well, and are raised with the least care of any breed I know. The Dorking fowls are considered in England the best table-fowl, but in this climate they have proved quite tender and difficult to raise, requiring a great deal of care.

For eggs and chickens, which are generally equally desired from fowls as usually kept upon farms, the testimony preponderates greatly in favor of the Brahmas; for, in addition to being good flesh fowls, both as to weight and quality, they are good winter, and may be considered at least fair summer, layers; they are quiet, hardy, and come early to maturity. Other breeds, considered superior in quality of flesh, or as egg-producers, may be found more desirable, being raised with equal success in many localities. Generally, however, the Brahma is considered the most profitable fowl for the farmer.

CAPONIZING.

Caponizing has been practiced but little in this country, the practice being now confined mostly to Pennsylvania and New Jersey. Mr. G. H. Leavitt, an experienced poultry-breeder of New York, says that 95 per cent. of the capons raised are raised in Pennsylvania, and that the same proportion of experiments is successful. In most parts of this country the practice is unknown, even among those who breed fowls for market. Both cockerels and pullets may be caponized, the latter being called in France *poulardes*. The effect of depriving them of reproductive powers is to cause them to fatten more easily, with less food: it increases their size beyond what would otherwise be attained, and makes them more tender and more desirable for the table. So much superior are capons esteemed to be, that it is singular the practice is so limited. Mr. Bishop, of Springfield, Ohio, before quoted, says of capons: "The weight is increased one-third, and the meat is much finer." Mr. Parker, of West Chester, Pennsylvania, says they command one-third more price than other market fowls. Mr. Robert B. Engle, of Masonville, New Jersey, who is qualified to speak from experience, says: "The operation is simple and easily performed. An expert in the business can castrate two hundred in a day, for which we pay four cents each. The capons fatten more readily than cocks, attain greater weight, and their flesh is much more tender and juicy, and is better flavored, and consequently commands a higher price, which in Philadelphia and New York, as compared with other prime chickens, is as 35 cents per pound are to 25 cents, which prices I received yesterday (February 5, 1871) in the Philadelphia market. The difference in price ranges from six to ten cents per pound, as to quality. * * I believe that if all roosters that are to be kept until full grown for market were properly castrated it would enhance

their value from 30 to 40 per cent." Mr. Engle gives the following memoranda of his sales in illustration of the superior market value of caponized fowls: "Seventy-one pairs of capons sold in February and March, 1870, the crop of the previous summer, weighed 1,313 pounds. Amount received, $463 89. Average weight per pair, 18½ pounds. Average price per pair, $6 53." Mr. Leavitt, of New York, also speaks highly of the increased value of capons over cockerels.

Instruments for making capons may be purchased for $5 per set, and consist of a spring, with which the incision, made by a sharp knife, is kept open during the operation; nippers and hook, with which to remove the covering of the testicles; a tube containing a silk-worm gut, with which the connection of the testicle with the bird is severed, and a spoon for removing the severed parts. The operation may be performed with more simple implements, however; as a sharp pocket-knife, a pair of forceps, a sharp-pointed hook, a horse-hair, and a teaspoon. The operation is performed in the following manner, as described by those familiar with it: Confine the fowl to a table or board, left side downward, by weights, or by straps which will securely fasten the legs and wings, the latter being drawn well over the back, and the legs extended backward, the upper one drawn farthest out. The head and neck should be left free. The position of the confined fowl is denoted in the accompanying cut.

Pluck the feathers from a spot an inch and a half in diameter, near the hip joint, and on a line from the hip to the shoulder joint. Draw the skin back, so that when left to itself again it will cover the wound in the flesh and make an incision between the last two ribs, commencing an inch from the back-bone and extending obliquely downward. The incision should be about an inch long, and only deep enough to separate the ribs, not wounding the intestines. The proper location for the incision is indicated by the line through the circle in the cut. The wound is kept open by a spring or otherwise for convenience of subsequent operations. Cut open the membrane covering the intestines, with care, pushing them with the spoon forward toward the breast-bone first, if they are not sufficiently drawn up. The testicles will then be exposed to view. They are connected with the back and sides by cords and covered with a thin membrane. The membrane must be seized with the forceps or nippers and torn open with the hook, commencing with the lower or left testicle, which is generally nearer the rump than the right one. Then introduce the tube containing the silk-worm gut, or the horse-hair, with which to sever the connection of the testicle, using the bowl of the spoon when horse-hair is employed to facilitate the operation, and with a sawing motion sever the chords. A similar process is repeated with the right testicle, and then both, with the blood around the wounds, are to be removed with the bowl of the spoon. The left testicle should first be removed to prevent the blood which may issue from it from covering the right one and rendering the operation more difficult. After the operation the skin must be drawn over the wound and a few stitches taken in it with fine linen thread, after which the fowl may be released.

Caponizing should be performed during a warm spell and as soon as the sex of the fowls can be discerned, and should be preceded by fasting them twenty-four hours and followed by feeding immediately after the operation, and during twenty-four hours, at least, on soft food. The caponized fowls will eagerly partake of food, and will be restored to health in a few days if the operation has been carefully performed. In making *poulardes*, it is sufficient merely to cut across the egg-tube with a sharp knife.

STATISTICS OF POULTRY-KEEPING.

The profit of poultry-keeping is shown, in the preceding pages, in the figures from the New York census, and in the individual examples cited, to be great. Some of the gentlemen who have furnished information for the present article assert that no other branch of rural husbandry is so profitable, considering the value of investments and the care bestowed. The demand for poultry and eggs, for food, is always good, both at home and abroad. As yet but little in this line has been furnished by this country for exportation, the shipments in 1868 amounting to only 19,604 dozens eggs, valued at $5,865, and poultry, valued at $1,484, or $7,349 in all.

In the Transactions of the California State Agricultural Society for 1868–'69, Dr. Holden states that New York City uses over four million dollars' worth of eggs each year. In nine months of the year 1869, however, the receipt of eggs in that city averaged about 1,000 barrels per day, a barrel containing 80 dozens, which, at 30 cents per dozen, amounts to $24,000 per day, or $8,760,000 per annum. It is probable that this supply was mostly used in the city. Boston uses half as many as New York; and Dr. Holden states also that Cincinnati annually exports twenty-five millions of eggs, and Stockton, California, about $300,000 worth of eggs and poultry. As very slight record of the poultry products of this country has been made, the statistics are meager. From October 14, 1869, to May 6, 1870, two buyers shipped to New York City, from the station at Masonville, Burlington County, New Jersey, 393,700 pounds, or nearly 197 tons of poultry, for which they paid the farmers of that vicinity not less than $95,000. Every country town easily accessible from our large cities is visited each year at the proper season by poultry buyers, who transmit to the city markets an immense aggregate amount of the surplus products of poultry-yards.

England is said to have a constant investment in poultry of over fifty millions of dollars, and she is the largest importer of eggs and poultry. The number of eggs yearly sent from Ireland, through Dublin, to England, is stated to be over seventy millions; almost equal to the average annual importation of eggs from all parts, from 1842 to 1847. During the succeeding five years the average annual importation was 103,000,000, being, in 1851, 115,526,236; and the London board of trade state the importations from France and Belgium, during the five years ending with 1857, to average 147,342,219. The numbers in the succeeding years, ending with 1861, averaged 163,581,140, the number in the last year being 203,313,310. The wholesale market price was eight cents per dozen, making the value of eggs imported that year $1,355,422. The quantity imported had increased in 1869 to 442,172,640, valued at $5,634,265, or $15\frac{2}{7}$ cents per dozen, and in 1870 to 430,842,240, valued at $5,510,400, or $15\frac{1}{3}$ cents per dozen.

M. de Lavergne, a high agricultural authority in France, as quoted in the Transactions of the Royal Agricultural Society of England, estimated the value of eggs produced in France, in 1865, at $24,200,000,

the exportations amounting to twenty-five million francs, or $4,650,000. The same gentleman estimated the value of the poultry consumed to be the same as the value of eggs produced, making an aggregate of eggs and poultry produced of $18,400,000. The investment in poultry in France is said to be over $75,000,000, or fifty per cent. greater than in England.

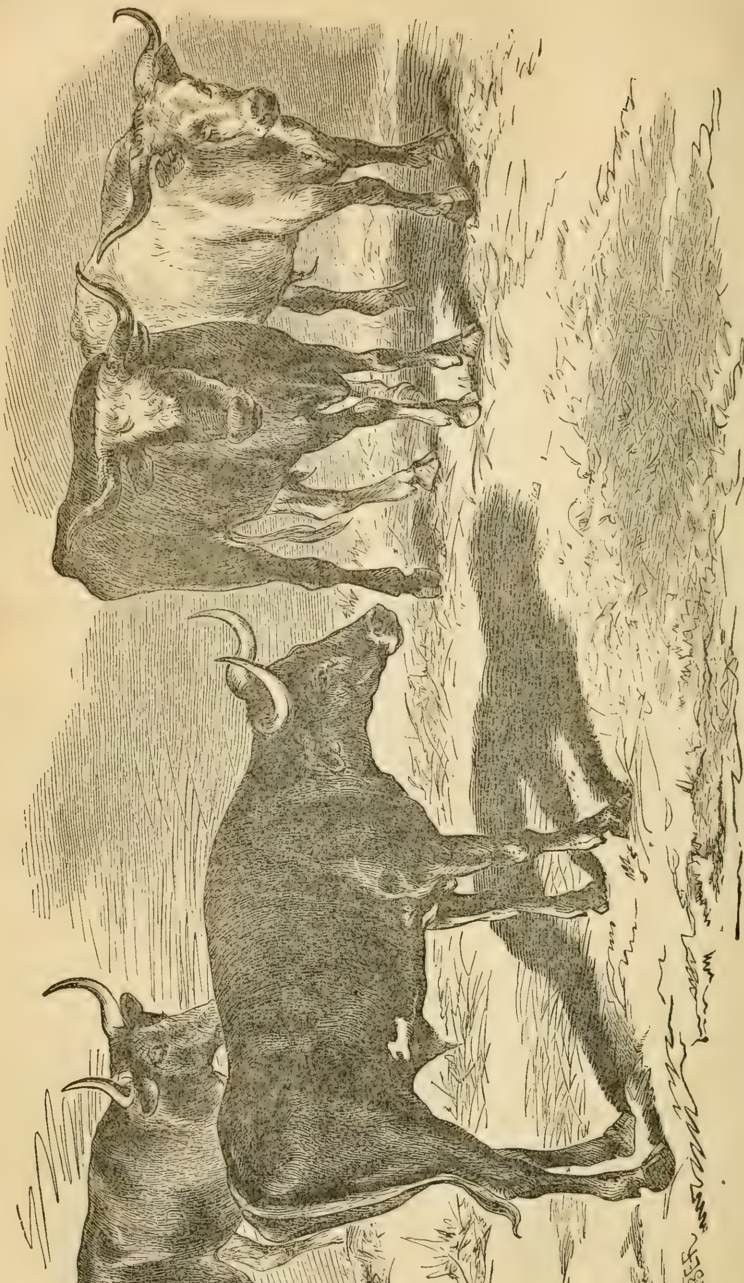
It is apparent that great profit is to be derived from poultry keeping at small outlay of means. There is always a fair demand in our principal cities and towns, at least, for considerable supplies of the products of the poultry-yard, and there is no danger of an over-supply which will reduce the business to the point of unprofitableness. The fact that fat chickens may be produced as cheaply for the table as any other meat, is worthy of consideration, in connection with their desirability as excellent food. The prices of prime poultry are almost always in advance of those of the best flesh of cattle, hogs and sheep, and it would be more frequently preferred by persons of small means in our cities if it could be procured at an equal price. It is indeed probable that home markets, with remunerative prices, may always be had, as they certainly may now be, by all American farmers, and especially by those convenient to the larger towns, who may choose to give a fair outlay of money, time, and intelligence to poultry-keeping.

THE TEXAS CATTLE TRADE.

Among the important developments of our domestic commerce, following closely upon the construction of the Pacific Railroads, is the Texas cattle trade, which has attained gigantic proportions, within the past three years. Previously, with greater obstructions to travel and longer distances to market, it had a slow growth. In all the more densely populated communities of the civilized world, the question of the continued supply of animal food long since assumed an important phase. Even on our own new continent, especially in the older settled portions on the Atlantic slope, the upward tendency of the meat market has long been remarked. If prices should continue to increase, as in the past few years, it requires no prophetic gift to foretell the transfer of animal food from the list of necessaries to that of the luxuries of life, attainable only by the middle or wealthier classes of society. The movements of population, the conditions of agriculture, and the developments of mechanical industry have been unfavorable to cheap meat production in the older States. In the Southern States population has tended hitherto to settle in the river bottoms, leaving immense plateau and mountain regions available to cattle-raising, but the system of agriculture prevalent in that section previous to the war was not favorable to this branch of industry. Its capacities in this direction have not yet been developed, and consequently no relief from the pressure can be expected from that quarter. The irruption of cheap beef from the Southwest is, therefore, very timely and acceptable.

Texas has been aptly designated the great cattle-hive of North America. More than half a century ago, under inducements offered by the Spanish colonial authorities in Mexico, the coast region from the Sabine to the Rio Grande, a level and fertile belt from thirty to sixty miles broad, was settled by Spanish and American emigrants, who

PLATE VIII



TEXAS CATTLE.

brought with them their native breeds of cattle, which, under remarkably favorable circumstances of climate and pasturage, amalgamated into a common stock, combining in a larger degree the better points of the constituent breeds. Up to the struggle for Texas independence the increase of these herds was remarkably rapid. In the disturbances and social dislocations which then ensued, the western portion of this cattle region became almost depopulated, and the cattle, for lack of owners, relapsed into a state of wildness. Social order was not finally reëstablished till after the annexation of Texas to the United States, and the treaty of peace with Mexico, in 1848. The cattle-raising industry then revived. The wild herds were either reclaimed by their former owners or appropriated by others. Large numbers were driven to eastern markets, but enough remained to stock immense ranches, on which a class of men of enterprise and resolute character have since organized a very thrifty pastoral industry. During the late rebellion the Texas cattle regions were but very slightly devastated by the ravages of war, which, on the contrary, greatly enhanced their prosperity by increasing the price of Texas beef. Its very large production has of late been rendered available to the public interest through the various lines of the Pacific Railroad system.

In the coast regions of Texas are found cattle lords whose animated treasures surpass, in number and value, even the flocks and herds of the great man of Uz. The Santa Cabrutas ranch, on the Santa Cabrutas River, owned by Colonel Richard King, embraces 84,132 acres of land, stocked with 65,000 cattle, 10,000 horses, 7,000 sheep, and 8,000 goats. For the management of these immense herds, 300 Mexican herdsmen and 1,000 saddle-horses are held in constant requisition. Colonel King each year brands 12,000 calves, and sells 10,000 fat cattle, constantly investing the surplus proceeds in stock cattle. O'Conner's ranch, twenty miles below Goliad, on the San Antonio River, in 1862 contained over 40,000 cattle; during that year on this estate 12,000 calves were branded, and $86,000 realized by the sale of cattle. This enterprise was inaugurated ten years previously, with 1,500 cattle. The Rohideaux ranch, between the Nueces and Rio Grande Rivers, owned by Mr. Kennedy, is a fertile peninsula of 142,840 acres, jutting out into the Gulf of Mexico, the isthmus being secured by thirty miles of plank fence, guarded at intervals of three miles by herdsmen's ranches. It already contains 30,000 beef cattle, besides large numbers of other stock. Other magnificent cattle-herds might be enumerated.

The net increase of cattle in this region has been estimated as high as 25 per cent. per annum prior to the opening of the Texas cattle trade. Turning his animals loose to graze at will over a range of country often fifty miles square, covered with nutritious grasses, in a genial climate, in which shelter is unnecessary, the Texas stock-raiser confines his care to the identification and marketing of his animals. For the former purpose the stockmen of the neighboring ranches assemble semi-annually in considerable force, to scour the country for the purpose of branding the calves, the ownership of which is determined by the brand borne by the cows they follow or suck.

This stock business, which has thus grown up from small beginnings, now amounts to a magnificent industry, the product of which reaches our most distant markets. Its conditions, both economical and productive, have been gradually changing with the growth of our resources. For several years after the annexation of Texas to the United States, the domestic market ruled very low. Stock cattle brought not over $4 or $5 per head, while beeves fattened for market did not command

more than double these prices. These rates, however, were abundantly remunerative under the conditions of cheap production then subsisting. When steamers began to touch at different points on the coast, and to ship beeves on the hoof to New Orleans and to other eastern and northern markets, the stock-raisers near the seaboard were soon able to realize double the rates above named. During the later years of the rebellion, the blockade of the coast and of the Mississippi River, by the Union forces, cut off nearly all access to markets; but since the return of peace, and especially since the opening of the so-called Texas cattle-trade, prices have been constantly advancing. At a convention of Texas cattle-raisers, held in Live Oak County during the last autumn, the following tariff of prices was fixed, viz: For first-class animals, $18 per head; second class, $15; third class, $11.

The extension of crop-raising agricultural settlements in the coast regions seriously deranged the conditions of cheap production of cattle, by raising the value of land and by restricting the range of free pasture. The stock business was then extended northward to the central region of high rolling prairies and even to the plateaus of Northern Texas, localities scarcely less congenial to this attractive industry than even the rich plains of the coast. They present large areas tolerably well watered, and sufficiently well timbered for the wants of the stock-raiser. The climate is mild and salubrious. The soil is a rich black mold, yielding, to a very imperfect culture, large crops of cereals and fruits. In their wild state the prairies are covered with excellent grasses, and already feed large herds of cattle, bearing the brands of different owners. Immense quantities of beef are annually lost, like the waste wood of the forest, for lack of means of preserving it. Hides rot on the ground for lack of tanneries, and because of the great cost of transportation to market, while imported leather is scarce and dear. Industry and trade are still in a very rudimentary condition, society being yet in a formative state.

Stock-raisers are found in this region with herds rivaling those of the coast. Eighteen years ago Mr. John Hitson was toiling amid the timber of Rhea County, Tennessee, to clear a little land for corn and wheat. Disgusted at the prospect of spending a lifetime in merely winning a foothold for future labor, he sold his land, and with 60 cows and 9 brood mares emigrated to what is now Palo Pinto County, on the Brogus River. He now owns 50,000 acres of land and as many cattle. Mr. John Chisholm owns 30,000 head, Mr. G. W. Slaughter 20,000, Coggins & Parks 20,000, Lacy & Coleman 12,000, Mr. Martin Childers 10,000. A large number of smaller but still very considerable herds, the product of a few years of intelligent enterprise, are reported in these regions, showing a rapid growth in the cattle industry, and a capacity for still greater expansion.

The number of cattle in Texas in 1870 is estimated at about 4 to 1 of the population; whereas, in the three great States of Ohio, Pennsylvania, and New York, the proportion is reversed. Texas is supposed to contain at least 3,000,000 beef cattle, besides 600,000 cows. There are annually raised and branded about 750,000 calves. From this basis of production, it is a question how long the demands of the present cattle-market can be met. The impression is beginning to prevail that the enormous exportation both of stock cattle and of fat beeves has measurably curtailed production. To such an extent has this movement increased, that even yearlings are now driven to the pastures of Colorado and Kansas to fatten for eastern markets. The great demand for stock has also induced the occupancy of ill-watered districts, resulting in a

large loss of animals by thirst. It seems probable that the capacities of the system hitherto pursued are about exhausted, and that more careful and economical methods and more scientific principles must be introduced into the business to enable it to meet the growing demand upon it. The ideas of the present race of stock-raisers, it is charged, are ultra-conservative and hostile to the introduction of improvements; but the rapid extension of railroad facilities into Texas will enforce an entire reorganization of this industry. The great primary depot of the Texas cattle trade is now at the Abilene Station, on the Kansas River, one hundred and sixty miles west of the Missouri River, four hundred and forty from St. Louis, and six hundred and seventy from Chicago. The special advantages of this locality were found in its admirable facilities for pasturing large herds of cattle beyond the settled portion of Kansas, upon a leading railroad route. The herds from Texas, however carefully driven, must necessarily arrive, after a march of seven hundred miles, in a very impoverished condition, while very many herds are driven without intelligent regard to the condition of the animals. From six to nine months' feeding in the genial climate, and abundant, well-watered pastures of this locality, where the plague of insects is unknown, is required to fit the stock for market. The shipments of cattle on the Kansas Pacific Railroad for the four years past are stated by Mr. A. Anderson, the general superintendent, in a letter to this Department dated December 17, 1870, as follows: In 1867, 30,000 head; 1868, 57,000; 1869, 47,000; 1870, 125,000. Of these aggregates he estimates that 97 to 98 per cent. were Texas cattle. The decline of shipments in 1869, as compared with 1868, was due to the statute of Illinois prohibiting the introduction of Texas cattle into that State during certain seasons of the year. The arrivals of cattle of all grades at the various stock-yards along the line of this road, during 1870, probably amounted to about 150,000.

The Union Pacific Railroad has made strong efforts to attract a portion of this trade by establishing at Schuyler, twenty-five miles west of Omaha, special facilities for the shipment of cattle, and by lowering the tariff of transportation charges. Notwithstanding the two hundred miles additional drive, as compared with Abilene, the business at this point has attained unexpected dimensions. Under date of December 16, 1870, Mr. T. E. Sickels, general superintendent Union Pacific Railroad, reports to this Department the shipment of 10,234 Texas cattle in 1870, besides 9,110 western cattle. The total shipment of any previous year was less than 500. It is thought that the local demands of Nebraska, Iowa, Minnesota, and Dakota will greatly enlarge this trade.

Baxter Springs, in Southeastern Kansas, on the Missouri River, Fort Scott and Gulf Railroad, promises to become a formidable rival to Abilene in this Texas cattle trade. Mr. B. S. Henning, superintendent, under date of December 15, 1870, reports to this Department the shipment of 85,000 head subsequent to June 1, 1870, the date at which the road was opened to Baxter Springs. This point is located one hundred and fifty-nine miles from Kansas City, and four hundred and forty-one from St. Louis, by the Missouri Pacific Railroad. The extension of the Atlantic and Pacific Railroad, now completed to Pierce City, two hundred and ninety-one miles from St. Louis, and at no great distance from Baxter Springs, will soon open a much shorter route to this traffic. In fact, this latter route, according to the statement to this Department of Mr. W. H. Paniarche, superintendent, dated December 16, 1870, gave transportation to 7,520 head of cattle in 1869, and to 40,960 head in 1870, of which latter aggregate 20,000 were known as Texas and Indian

cattle. Mr. W. H. Downes, general superintendent of the central branch Union Pacific Railroad, reports the shipments of cattle over that line, in 1870, at 112 car-loads, or, at an average of 20 head per car-load, 2,240 head. This road is completed from Atchison to Waterville, Kansas, one hundred miles.

The general northward movement of Texas cattle during 1870 is variously estimated between 100,000 and 200,000 head. The aggregate shipments of the five railroad lines above mentioned were 252,000. How large a portion of these cattle were from the Indian Territory there is no means of determining, inasmuch as these are consolidated with the Texas cattle in all the reports. The estimates quoted do not appear to be extravagant. The cattle brought to market by these lines of transportation are from Northern or Central Texas, those of the coast regions finding a more eligible market by sea. They were bought by the herd in Texas during 1870 at about the following prices, viz: Beef cattle, $11 per head; milch cows, $6; three-year olds, $7; two-year olds, $4; yearlings, $2 50. When only beef cattle were bought, the prices ranged higher, averaging from $12 to $14 per head. The average drive to Abilene, seven hundred miles, occupies about two months, and costs about $2 per head, besides a margin of 20 per cent. for stampeding, stealing, &c. Arriving at Abilene in tolerable order, a mixed drove will command about the following prices, viz: Beef cattle, $20 per head; milch cows, $12; three-year olds, $10; two-year olds, $8; yearlings, $5. After grazing through the summer, their market value is advanced 20 to 25 per cent. Beef cattle, well matured for market, readily command $25 per head.

Chicago has largely controlled the Texas cattle trade since its inauguration, but St. Louis is organizing a formidable competition, with the advantage of shorter lines of communication with the cattle regions. It is evident that the present arrangements of the traffic are mostly provisional and temporary. This great mass of production cannot remain dependent upon the present imperfect outlets to market. The monopoly of transportation, now enjoyed by the Kansas Pacific Railroad and its connections, will be broken up when the southwestern lines, now in progress, shall have been completed. Cattle shipments to eastern markets, over these shorter lines, will be preferable to those over the long elbow-routes through Chicago and St. Louis.

The prices of beef on the hoof in the New York market during the first ten months of 1870 averaged about 8 cents per pound, or about double the rates ruling in Chicago and St. Louis. The animals average about 900 pounds, representing a valuation of $72, and costing the importer about $55 per head—a profit of about 30 per cent., counting all incidental and unavoidable risks. In the St. Louis and Chicago markets the Texas steer represents a value of about $31 50 per head, at 3½ per pound. The expense of bringing him to the abattoir of these cities is about $23, leaving a profit of $8 50, or nearly 40 per cent. Chicago live-stock reports mention the fact that Texas cattle lose less weight in dressing than Illinois cattle, and can, therefore, be sold at fine margins to carcass-butchers. Beef-packers assert their superiority for packing to the rough, coarse stock previously imported from west of the Missouri River, being finer-grained, richer, and more tender. Their hides are also worth from 15 to 20 per cent. more, and their yield of tallow is larger.

The Chicago live-stock reports, during the latter half of 1870, represent a continued and increasing pressure of Texas cattle upon the market. The extreme range of prices has been between $2 and $7 per hun-

dred pounds, for thin stock cattle and for well-matured fat beeves, respectively. In the lower grades Texas cattle have mainly monopolized the market. The low prices caused by this abundant supply have influenced all the markets in the country. In the opinion of intelligent cattle dealers in Chicago, the immense cattle irruption from the Southwest has alone prevented the average price of beef, live weight, from ruling as high as 12 cents per pound in the eastern markets. Complaints have been heard from even New England farmers of their being compelled to accept lower prices than had been anticipated. There is scarcely room to doubt that the Texas cattle trade has been overdone, and that the late abundant supply has been secured at the cost of a crippled production in the future.

The influence of the Texas cattle trade has hitherto operated as a disturbing force, deranging, to some extent, old arrangements of supply and demand in the markets generally. Some of its results upon the meat production and supply of the country are already foreshadowed. The States north of the Ohio have hitherto furnished the main supply of animal food to the eastern markets. If the present conditions of cheap beef production in Texas should be perpetuated, or if the grazing capacities of our great central mountain region should be speedily developed, of which there is now ample promise, those States will be compelled to yield entirely the production of lower grades of beef. The extension of railroad facilities is constantly enlarging the area of pasturage immediately available for cheap beef production. In the case of Texas cattle, many drawbacks to the trade will be removed. The long drive of seven hundred miles will be abandoned. Farmers, upon land costing from \$20 to \$200 per acre, in climates requiring four or five months' winter feeding, cannot compete with stock-raisers operating under a sky that demands no shelter, and upon a soil yielding perennial supplies of green food where land is now so cheap that a single stock-farm includes a whole county.

The farmers of the Northwest must secure more valuable breeds of stock. They must select animals which, with the same acreage of summer pasture and the same amount of winter feeding, will yield beef in greater quantity, of finer quality, and of higher market value.

The more intelligent cattle-raisers in the older States have already anticipated this necessity by supplanting their common stocks with improved breeds of cattle. The pressure of circumstances will drive the farming interest generally in the wake of these pioneers, and a speedy demand for superior animals may be expected. In the next ten years we may anticipate an immense improvement in the stocks of the Northwest. For such there is no danger of a failing market. While wealth, under our free civilization, is accumulating and diffusing itself through more numerous classes of society, the demand for better food will keep pace with any improvement in production that may be made. In this branch of the business, Texas cattle-raisers, under their present conditions of production, can offer but slight competition. To raise the finer breeds of cattle will involve a revolution in their whole system. It is one thing to send out, from time to time, gangs of Mexican vaqueros to lasso and drive in the spontaneous products of wide, unoccupied wastes of rich pasture, but entirely another thing to operate within narrower limits, and to develop the latent resources of nature by a scientific application of her higher laws. It is unreasonable to expect a sudden change in the loose methods of production now employed in the Southwest; but the time is coming when such a change will be a necessity. The pressure of population and the rise in the value of land will soon

demand greater economy of resources. Wide-spread pastures will be restricted by farming inclosures, and the ability to produce coarse beef at low prices, without any of the expenses of the Northern and Western stock-grower, and with less scientific intelligence, will no longer exist.

The Texas cattle trade has its evils, which should be ameliorated. The transportation of cattle for great distances by rail involves many abuses. Healthy animals suddenly removed from the free range of pasture and crowded into cattle-cars, kept standing for days and nights in an uncomfortable posture, deprived of food and rest, worried and confused by the constant roar of machinery, cannot long preserve their healthful condition. In the hot summer months, bodily exhalations create an intensely mephitic atmosphere; the jarring, unequal movements of the cars jostle the animals against each other, injuring their limbs, abrading their flesh, and adding cutaneous and muscular inflammations to the other evils of this "middle passage."

Different State legislatures have attempted to relieve these difficulties by special enactments. New York forbids the confinement of live-stock for longer consecutive periods than twenty-eight hours, without intervals of ten hours for rest. Inventive genius is also devising more comfortable cattle-cars. It can render the most effective service in the perfection of refrigerator cars, whereby the animal may be slaughtered on his native soil, and the meat sent to distant markets, preserved by artificial refrigeration perfectly fresh and untainted. This method has already been successfully inaugurated in some portions of the country, and there is but little doubt of its general introduction when the requisite machinery shall have been devised and constructed.

This improvement is now urged by that noble institution, the "American Society for the Prevention of Cruelty to Animals." This body deserves the gratitude of the public for its fearless and disinterested exposure of the abominations of the New York abattoirs, ventilating not only the cruelty to animals, but also the frauds perpetrated upon the public. Evils of this character, however, intrenched as they are in the inveterate selfishness of interested classes, can be alleviated only to a slight extent by moral or even legal suasion. A change in the method of marketing beef will remove the abuses complained of by removing the opportunity for their perpetration. The public will hail with genuine satisfaction that revolution in the beef trade which secures the slaughter of the animal in his native pasture, and the transportation of healthy beef in refrigerator cars.

EPIZOÖTIC APHTHÆ.

NATURE OF THE DISEASE.

This contagious malady of stock belongs to the class of zymotic diseases, or, in other words, it is caused, like specific fevers generally, by the introduction into the system of a poison germ, which propagates itself and increases in the blood and tissues in a manner allied to the growth of a ferment in a saccharine solution. During this reproduction of the virus in such fevers, the system passes through a series of successive stages of disease, the nature and duration of which are determined by the character of the particular poison taken in, and during which the poison germs (contagious principles) are given off abundantly

by one or other or all of the secreting surfaces. Hence, like other zymotic diseases, this is altogether specific in its cause, its nature, and its mode of propagation. As known in Western Europe and America, this disease is invariably due to a virus or contagion thrown off by some animal suffering from the disease; it is always manifested by a slight preliminary fever, and a period of eruption and decline, and these are respectively of constant and well-defined duration. These different periods of the disease are characterized by varied manifestations. The first period is that of *incubation*, during which the poison germs are in the body of the animal, and propagating themselves there, but have not yet affected the constitution so as to impair the functions, or give rise to the more manifest symptoms of illness. Toward the end of this period, however, the thermometer shows an increase of temperature, in the interior of the body, of about two degrees beyond the natural standard. This period lasts twenty-four to forty-eight hours, though in rare cases it may apparently extend to a week.

It is followed by the *period of eruption*, which is first manifested by the redness, heat, and tenderness of the udder and teats, of the space between the hoofs, and of the membrane of the mouth. In the course of one day more, these parts are found to be the seat of numerous hemispherical elevations or blisters, caused by the effusion of a clear yellowish fluid from the blood-vessels beneath the cuticle or scarfskin. These increase in size for the next two or three days, burst, and dry up.

The *period of decline* is marked by the drying and scabbing over of the sores caused by the rupture of the blisters, and by the reproduction of the lost cuticular covering or scarfskin. The elevated temperature, which had declined somewhat on the appearance of the blisters, now entirely subsides, unless maintained by exposure, or the irritation of the sores by dirt or other bodies. This period has passed and the disease is at an end by the fifteenth day, in favorable cases.

CAUSES.

The only known cause of itself capable of inducing the disease is *contagion*, or contact of a sound animal with the virus discharged from the sores of an *aphthous* patient. Many accessory causes may be named, such as a wet, muddy season, which insures the contact of the virus deposited on the soil with the skin about the top of the hoofs; the accumulation of cattle in large fairs or markets; the aggregation of large numbers of live stock for the supply of armies in the field; travel of stock by rail or road, and the like. Yet these are but means of the diffusion of the poison, while no one of them, nor all taken together, can call the disease into existence where the poison is not already present. Though prevalent extensively in Europe during or after almost every great war since 1695, it did not reach Great Britain till 1839, when it was brought by some Dutch cattle imported into London. In the same year it was brought by Dutch cattle to Cork, Ireland; and, as free trade in continental cattle was established four years after, it has been since steadily maintained by the constant importations. In 1841 it is first reported in Denmark, a country which breeds its own stock, and rarely imports any. Last year appears to have been the first time it appeared on American soil, and it has not yet reached the great stock ranges of Australia. In Great Britain it spreads widely every year, after the great autumn markets, in which home and foreign store cattle mix freely, and yet there are in that country many breeding districts into which strange stock are never taken, and where the disease has not yet pen-

etrated. It prevails very frequently on cattle dealers' farms in the same country.

Such comprehensive facts as these narrow the list of real causes down to the simple contact of the virus with a healthy animal. This virus, however, is perhaps the most contagious known. It is often carried on the clothes, boots, and hands of men; on the fibers of hay or straw; preserved on the walls, floors, mangers, and other fittings of buildings; on stable utensils; in yards, parks, roads, and railroad cars; on drinking troughs; or it may be carried on the legs or bodies of dogs, chickens, rats, and other animals which themselves escape the infliction. In short, any solid body may retain, and be a bearer of, this contagion. Fortunately, it does not spread to any extent in the atmosphere. Nothing is more common than to find a herd on one side of a road struck down by the disease, while another in a field on the opposite side of the road remains perfectly healthy. It may be carried by a strong wind in the form of the virulent saliva, or the virus may dry up on light bodies, such as paper, hay, &c., which are afterward borne off by the wind. It may be carried by men or animals, or by water running from the diseased to the healthy lot; but, in the absence of such agencies, the breadth of a common road is amply sufficient to circumscribe the disease.

RELATIVE SUSCEPTIBILITY OF DIFFERENT ANIMALS.

Cloven-footed animals appear to be the natural victims of this disease, and all species are about equally obnoxious to its attacks; but it may be communicated to many if not all other warm-blooded animals by inoculation or by contact of the virulent discharges with their mucous membranes.

Its transmission to man has been noticed during almost every great outbreak since that of 1695. It has been reported, among others, by Valentine, Nadberny, Levitzky, Kolb, Hertwig, Rayer, Besquet, Londe, Levigny, Dundussy, Hübner, Holmes, Balfour, Karkeek, and Watson. Cases of the disease in man have been seen in Albany and at South Dover, Dutchess County, New York, during the present outbreak. It shows itself in man by slight feverishness, and the formation on the tongue and inside the lips and cheeks, and sometimes on the hands, of small blisters, rarely amounting to the bulk of a lentil. In children and young animals, feeding exclusively on milk, diarrhœa and fatal inflammation of the stomach and bowels occasionally supervene. It is further to be dreaded that the malady, gaining a lasting hold on the dairies of our large cities, may swell the lists of mortality of the infant population by inducing those fatal diarrhœas and enteritis reported by Hübner, Balfour, and Watson.

Its existence in *horses* is reported by Sagar, Cleaver, and Laubender, but the susceptibility of the soliped is very slight, and he can probably be affected only by inoculation.

In *chickens* it has been frequently noticed—among others, by Hennicke, Sagar, Lamberlicchi, Dickens, and Youatt. Chickens were attacked in December, 1870, on the farm of Mr. Eighmie, La Grange, Dutchess County, New York. Drinking the castaway milk is probably the common cause. Dogs and cats have been noticed by Lagar, Younghusband, and others, to suffer from drinking the milk. A shepherd's dog at Mr. Eighmie's suffered from the disease, and another, Mr. Preston's, South Dover, New York, had only partially recovered when seen by the writer.

SYMPTOMS.

The victims may usually be picked out from a herd, twelve to twenty-

four hours before they show distinct signs of the disease, by the increase of temperature indicated by a clinical thermometer introduced into the rectum and retained there for three minutes.

In *cattle* the eruption may be concentrated on the mouth, (including the muzzle and nostrils,) on the udder and teats, or on the space between the hoofs, though it usually attacks all of these parts simultaneously, and in rare cases even extends to the general integument or to the mucous membrane of the throat, stomach, and bowels, or other internal organs. The symptoms are slight shivering or roughness of the coat, neglect of feeding and rumination, redness, heat, swelling and tenderness of the pasterns, teats, and mouth, arching of the back, and a crouching, hesitating gait, accumulation of a white froth around the margin of the lips, and a loud smacking noise made by the tongue and lips. On the second or third day the blisters may be seen on the gums, on the dental pad behind the upper lip, on the tongue, on the teats, and around the upper borders of the hoofs and between them. In twenty-four to thirty-six hours more (sometimes at once) these burst, the cuticle is detached, and raw pink sores are left, most noticeable on the mouth and teats. With care the process of healing goes on rapidly, and is completed about the fifteenth day. Complications are rare, unless as the result of neglect, and consist in inflammation and loss of the udder; extensive formation of matter beneath the hoofs, causing them to be shed; extension of disease to the sinews, bones, and joints of the foot, with wide-spread destruction of parts; eruption on the stomach or bowels, with dangerous or fatal inflammation; or implication of the womb with abortion or long-continued weakening discharges.

In *sheep* the feet are mainly affected, and the malady bears a strong resemblance to *foot-rot*, and, under neglect, may merge into this.

Swine also suffer severely in the feet, and, as they are too commonly neglected and left on mud and filth, shedding of the hoofs is frequent. When the mouth suffers they champ the jaws, and frothy saliva collects around the lips.

LOSSES OCCASIONED BY THE DISEASE.

These can only be estimated by considering that every ruminating animal and hog exposed to the poison will almost invariably contract the disease; also, that the poison may be dried up in barns and elsewhere without losing its vitality or virulence, and thus be preserved for months and years. The depreciation of ordinary store and feeding stock, which have passed through the affection, may be approximately stated at $5 to $10 per head—sheep and swine at relatively smaller amounts; but for dairy stock no such low estimates can be accepted. There is first the loss of the milk for thirty days, $25 to $30 per head. Several Dutchess County farmers were losing at the rate of $20 per day, or $600 per month, from this cause alone, at the time of our visit. Then there are the frequent consequences of loss of the bag, or of the hoofs, abortions, and chronic discharges from the womb, which unfit the subjects for dairy purposes; and, lastly, internal complications and fatal results. Such results imply serious losses for individuals, counties, or States; but the great danger lies in the possible migration of the disease out west, and its final diffusion throughout the States. This is much less unlikely than was its importation from Europe nine months ago. We had then the safeguard of a restriction on direct importation; but now let a valuable Short-horn be sent from Massachusetts, or New York, to Minnesota, Illinois, Missouri, Kansas, or Texas; let him contract the disease on the roads or railroad-cars, and convey it to the stock among

which he is sent, and the chances are that all the more eastern States will suffer in turn. The aggregate loss in such a case would be virtually incalculable, and if the disease gained a permanent footing among us it would be liable to recur more or less widely at intervals of a few years.

ORIGIN OF THE PRESENT OUTBREAK IN AMERICA.

Though no unbroken chain of evidence concerning the source of the present outbreak is forthcoming, no one acquainted with the nature of the disease can for a moment doubt that it was imported from Europe. Though certainly prevailing in Central Europe for nearly two centuries, it reached Great Britain only in 1839, Denmark in 1841, and America in 1870. No atmospheric or climatic changes would account for such results. Diseases like *influenza*, which appear to be due to such vicissitudes, sweep over simultaneously, or nearly so, our continents and islands, and even ships in mid-ocean, whereas this is circumscribed for centuries by a narrow sea, or well-guarded neck of land, and crosses only when the victims are allowed to pass. Moreover, in each of these cases a definite importation can be traced. Confining our remarks to the case of America, we have before us all the facts of our importation of the disease from England, in 1870. Not being at liberty to mention names, which would serve no good purpose, we can merely state that cattle shipped from an English port, in August, showed signs of the disease when two days at sea, passed through it on the ocean, and landed apparently well, but conveyed it to the stock among which they were placed on their arrival in Canada. Whether it spread from this point, or whether there was another importation, there is no evidence to show. Its existence at Oriskany, Oneida County, New York, was reported in September about the time of the State agricultural show at Utica, supposed to have been brought by Canadian cattle, but subsequent inquiry has failed to afford anything more than report for this alleged origin. At different times from the 15th of November to the 7th of December it was brought into Dutchess County, New York, by five separate droves from Albany, which had been carried last on the New York Central Railroad. It prevailed extensively, and caused great losses at Amenia, Pawling, South Dover, Dover Plains, and La Grange. From Dutchess County it was conveyed into Connecticut, and spread widely in New Milford, Sherman, and Kent. From Albany it was conveyed in a drove to the valley of the Connecticut River, and spread in the towns of Hadley, Hatfield, Northampton, and East Hampton. Cattle from Albany also conveyed the disease to Brighton, Massachusetts, and spread it extensively around Boston, at Concord, Ipswich, Newburyport, Acton, Sudbury, &c., reaching at some points into New Hampshire. It has more recently gained a footing in Rensselaer County, New York.

TREATMENT.

Under this head little need be said. Keeping the bowels open by soft diet, or, if necessary, mild laxatives, administering nourishing gruels if the animal threatens to sink, and keeping the seat of eruption scrupulously clean, will usually suffice. No vaunted preparations for the *cure* of the disease will really cut it short, as it passes through its successive stages, and terminates in recovery in ten to fifteen days, the time at which the venders of specifics claim that a cure can be effected. A dry floor must be secured, with perfect cleanliness, and the sores may be washed daily with a preparation of one part of carbolic acid dissolved in fifty or a hundred parts of water. For the teats, glycerine

may advantageously replace the water. The milk must be fully withdrawn, using a silver milking-tube if the teats are sore and the cow restive.

PREVENTION.

Importation of ruminants and swine from all countries where it exists should be allowed only under the restrictions of a week's quarantine, examination by a competent veterinary surgeon, and sponging of the skin with a solution of carbolic acid.

Diseased stock should be carefully secluded, together with infected barns, yards, fields, fodder, rugs, buckets, and other utensils. One person should be appointed to attend to them, and forbidden to go near other stock, and even to cross a road or other place frequented by stock, until he has washed his boots with the carbolic-acid solution. All other persons and animals should be excluded. Inspectors should wash and disinfect on leaving.

Infected roads should be closed for a month at least. In infected countries or districts, all movement of live stock (cattle, sheep, and swine) should be prohibited except under a written permit from the local authority, who should assure himself of their soundness before granting it.

Railroad-cars, yards, and loading-banks on which diseased stock have been should be well washed or scraped, and then thickly sprinkled with carbolic acid.

A similar thorough disinfection of infected buildings, yards, utensils, rugs, &c., is equally essential. Manure should be removed, and plowed under by horses.

No new stock should be brought on the same premises until after thorough disinfection, nor upon infected fields until one or more months after the last sick animal has left.

While the disease prevails in the same State, or in an adjacent one, newly purchased stock should be placed on quarantine, in a separate building or park, with separate attendants, for a fortnight after purchase.

During the prevalence of the disease the milk cannot be safely used, but to young animals it may be given with impunity if it has first been boiled.

STRUCTURE AND DISEASES OF THE HORSE'S FOOT.

Probably more than $500,000,000 are invested in the horse stock of the United States. This value is exceeded only by that of cattle by a small percentage. The average value per animal is not far from $75. This low value results, in part, from including in the calculation animals of all ages, and all degrees of health and soundness. Without doubt one great cause of this low average value is the wide-spread carelessness that obtains among farmers in regard to breeding. The idea that "a colt is a colt," leads to entire indifference to the source from which it is obtained. Consequently our pastures, highways, and markets exhibit a large proportion of inferior animals that hardly pay for the raising. But a very general and powerful influence in the depreciation of horse values is found in constitutional and local defects and disabilities, which are probably exhibited in some form of lameness in eight or nine in every ten cases.

Consideration of the structure of the foot of the horse, of the manner

in which it is shod, of the roads on which it is used or abused, and the general lack of care in its management, lead us to wonder, not that lameness is so frequently met with, but rather that it is not more frequent—that any horse escapes it.

Lameness *may* exist in any part of either extremity, from the shoulder or hip to the foot. But, practically, its frequency increases as you go from the body toward the feet. For one case of *shoulder* lameness, except as the result of direct violence, you will see many of the foot. In nine cases in ten the seat of the lameness will be found within the terminal twelve inches of the limb, and within this limit the parts that most frequently suffer are those inclosed by the hoof. A brief glance at the anatomy of the foot will show the probability of this statement.

The horse stands and goes upon the end of one finger in each limb, and bears his entire weight on four such finger-ends. These ends are covered or surrounded by hard, horny cases, *the hoofs*. The hoof being nearly unyielding in the artificial condition of those animals that are kept shod with iron shoes and stabled upon hard and dry floors, even the most moderate degree of inflammation of the soft parts inclosed must be productive of great pain. Every one who has suffered from a felon knows the agony it causes; but the felon is only an inflammation, with suppuration, under a tissue less dense, less unyielding, than the hoof of the horse. In addition to this, the inflamed tissue, at every step, is compressed between the bone, the actual point of support, and the investing hoof, by a portion of the weight of the body.

ANATOMY OF THE FOOT.

The foot of the horse is made up of a variety of tissues. Commencing at the outside, we find a dense horny envelope, *the hoof*, and within this, *fascia*, *cartilage*, *cellular* and *fibro-cellular tissue*, *vessels*, and *nerves*, and still within these a center of bone. The bones of the foot are portions of the general frame-work or skeleton, and correspond in their general plan of structure with the terminal bones of the fingers in man. Before proceeding to a description of these, we will give a moment's attention to the comparative anatomy of the part.

The bones, muscles, blood-vessels, nerves, and other tissues of the fore legs of the quadrupeds of the mammalia are constructed upon the same plan as the arm of man, having essentially the same parts, and these with the same mutual relations. Whatever difference appears may be traced directly to that economy in nature which adapts the simplicity or complexity of structure to the extent, variety, and degree of use. So the greater simplicity of structure observed in the fore leg of the horse, compared with that of the arm of man, is due to the fact that its use is limited to the support of the body and its progression. By reference to Figs. 1* and 2†, the various bones of the legs may be compared to corresponding portions of the human body. By reference to Fig. 1, the plan on which the simplification of the bony tissue of the animal foot, as compared with the hand and foot of man, is accomplished, may be seen.

As will be noticed, the relations between the parts of a foot are con-

* FIG. 1.—View of the digits present in the feet of different animals, from the elephant, having an equal number with man, to the horse, having but one; showing also the order in which they are dropped: I, first digit, corresponding to the great toe of man; II, second digit; III, third digit; IV, fourth digit; V, fifth digit.

† FIG. 2.—Plan of construction of horse's foot from Allen: I, II, in each figure represent corresponding portions of the foot in the human and horse's foot; *a*, *cl*, *s*, *cb*, cn^1, cn^2, cn^3, bones of the tarsus; m^1, m^2, m^3, m^4, m^5, metacarpal bones; 1, 2, 3, 4, 5, digits; p^1, p^2, p^3, phalanges; x - - - - , indicating an axis of bones constantly present in the foot of every mammal.

PLATE IX.

Fig. 1

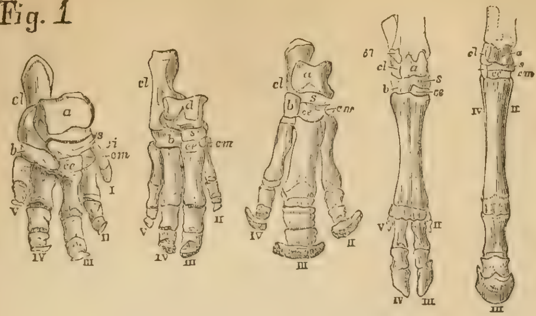


Fig. 2

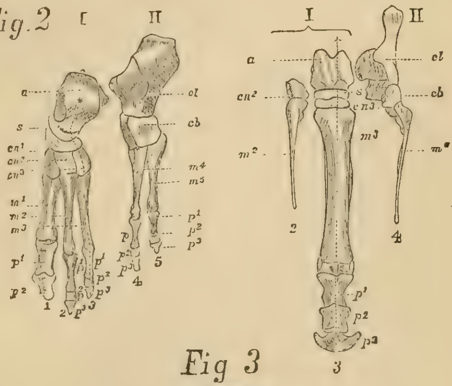


Fig 3

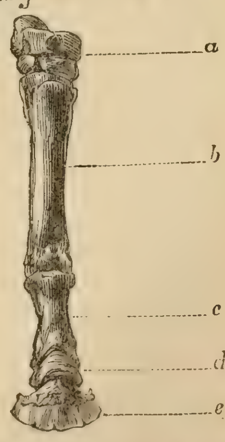


Fig. 1. View of the digits present in the feet of different animals.
Fig. 2. Plan of construction of horse's foot.
Fig. 3. Bone of fore leg, front view.

PLATE X.

Fig. 4

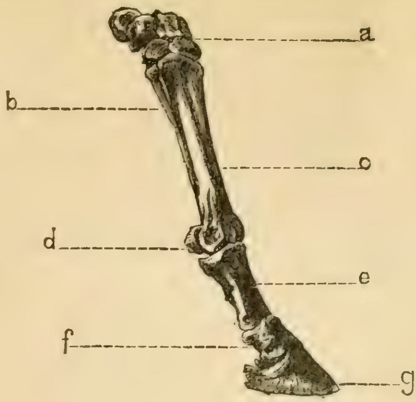
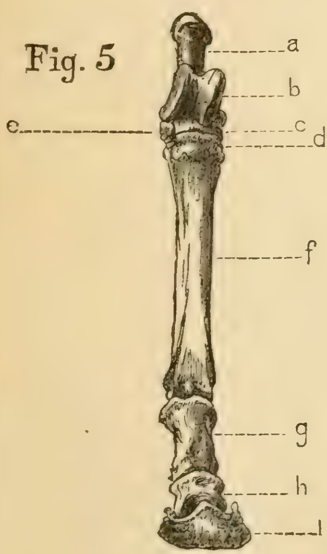


Fig. 5



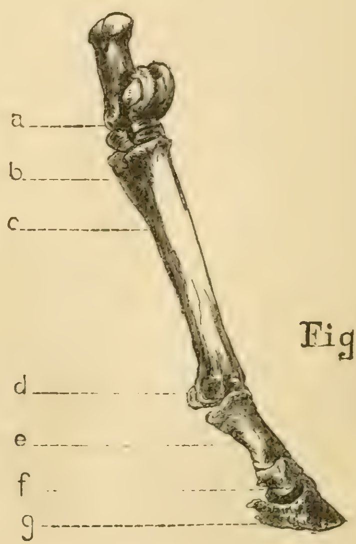


Fig. 6

Fig. 4. Bones of fore leg, side view.
Fig. 5. Hind leg, front view.
Fig. 6. Hind leg, side view.

stant. Whatever parts are dropped are from the sides, with corresponding modifications of the carpal and tarsal elements. This dropping of digital elements to contribute to greater simplicity of structure is not confined to the foot of the horse; indeed, it has its most complete manifestation short of obliteration in this animal, but is seen to a less extent in other animals. Taking five toes as the highest number present in any land mammal, we have a reduction to four in the hippopotamus, to three in the rhinoceros, and two in the ox. The elements not used are frequently present in rudimentary form, as seen in the splint-bones of the horse and the two small toes in the ox and hog. Fossil skeletons of horses show that in previous geological eras horses have lived having, in addition to the fully developed single digit, two others, perfect as to form, but smaller in size.

The *anatomical* foot of quadrupeds consists of all the parts beyond the radius, or radius and ulna, of the anterior extremities, and the tibia, or tibia and fibula, of the posterior. This would include the carpal bones, (*the knee*,) and the bones below, of the anterior, and the tarsal bones, (*the hock*,) and bones below, of the posterior extremities. In point of fact, however, uses considered, the foot of the horse is much more limited in its extent, including only the terminal phalanx—Fig. 2, "p. 3," a portion of the middle phalanx "p. 2" and a sesamoid bone, *the navicular*, at the posterior aspect of the joint between the two. (Fig. 14,* "2," "3," "4.") Below the *carpus* (Figs. 3† and 4‡, "*a*") of the anterior, the *tarsus* (Figs. 5§ and 6‖) of the posterior extremities, the bones of the leg have similar common names, and are essentially alike in corresponding regions. Immediately below the carpus and tarsus is a single large metacarpal or metatarsal bone, called the *cannon-bone*, (Figs. 3, 4, 5, 6.) Upon either side of this is a rudimentary bone, the *splint-bone*, (see Figs. 4, 5, 6, and 7.) These two splint bones, expanded at their upper extremities, where they enter into the formation of the knee and hock joints, grow gradually smaller as they pass down by the side, and rather to the rear of the main bone, and terminate before reaching the fetlock joint. Below the cannon-bone, taking an oblique direction anteriorly from it, is the *pastern*-bone, (Figs. 3, 4, 5, 6, and 8,) (*long pastern, os suffraginis.*) In length it is from one-third to one-half that of the cannon-bone. Below this is the *coronet-bone*, (Figs. 3, 4, 5, 6, 9,) (*short pastern, lower pastern, os coronæ*,) which is nearly square in form; its transverse diameter being, however, greater than its vertical. The last bone terminating the extremity is the *coffin-bone*, (Figs. 3, 4, 5, 6, and 10,) (*os pedis.*) This bone is described as having a body and wings. Its general outline is semilunar anteriorly, superiorly it is convex, and posteriorly and inferiorly it is concave. In texture it is light and spongy, perforated throughout by canals, (Figs. 16¶ and

---

* Fig. 14.—Vertical section of the foot of the horse, copied from Owen: 1, pastern-bone; 2, coronet-bone; 3, navicular bone; 4, coffin-bone; 5, extensor tendon; 6, part of common flexor tendon; 7, deep flexor tendon; 8, posterior expansion of great cartilage; 9, soft cushion of the heel; 10, section of horny hoof; 11, sensitive hoof; 12, anterior section of the cartilage spreading over the coffin-bone.

† Fig. 3.—Bone of fore leg, front view: *a*, bones of carpus; *b*, cannon-bone; *c*, pastern-bone; *d*, coronet-bone; *e*, coffin-bone.

‡ Fig. 4.—Bones of fore leg, side view: *a*, bones of carpus; *b*, splint-bone; *c*, cannon-bone; *d*, sesamoid bone; *e*, pastern-bone; *f*, coronet-bone; *g*, coffin-bone.

§ Fig. 5.—Hind leg, front view: *a*, *b*, *c*, *d*, *e*, bones of the tarsus; *f*, cannon-bone; *g*, pastern-bone; *h*, coronet; *i*, coffin-bone.

‖ Fig. 6.—Hind leg, side view: *a*, bones of the tarsus; *b*, splint-bone; *c*, cannon-bone; *d*, sesamoid bone; *e*, pastern-bone; *f*, coronet-bone; *g*, coffin-bone.

¶ Fig. 16.—Posterior view of the coffin-bone, showing the openings into the interior canals, through which branches of the plantar arteries and veins enter: *a*, *a*, *a*, *a*, entrance to canals.

17,*) through which blood-vessels and nerves are abundantly distributed to the soft and sensitive tissues that cover it. The wings extend directly backward from the body, and support the lateral cartilages. Upon its superior aspect is a smooth and concave surface, placed obliquely to the body of the bone for articulation with the middle phalanx or coronet-bone. Applied to the joint between the coronet and coffin bones, posteriorly, and lying in the concavity of the coffin-bone, is a small bone of peculiar shape—the *navicular*, (Fig. 14, "3.") This is a sesamoid bone, being contained in, or attached to, the tendon of the deep flexor. It is from two to two and one-half inches long, three-fourths of an inch in width at its widest part, and half an inch in thickness. Two surfaces of this bone, meeting in front at an acute angle, are covered with cartilage and synovial membrane. The posterior surface is rough for the attachment of the tendon of the deep flexor.

Attached to the upper edge of the wings of the coffin-bone are the two lateral cartilages. They are irregular in form, elastic, and extend backward, giving form, substance, and elasticity to the heel upward as high as the pastern joint, and forward, so that only the width of the great extensor tendon of the foot separates them. In fact, the fibrous investment of the tendon is attached to these cartilages.

This widely distributed cartilage may be observed passing downward and surrounding on every side the rough and knotty extremities of the heels of the coffin-bone, entering and filling up its sinuosities and taking strong attachment to these processes. It then extends horizontally inward, passing over the horny sole and bars, and, meeting the sides of the sensitive frog, intimately unites with it, forming one inseparable mass and filling together the whole interior area described by the sides of the coffin-bone. The upright or lateral portion of the cartilage forms with the horizontal portion passing inward a right angle, thus making together a hollow space or receptacle at the back of the coffin-bone that contains the spongy, elastic stuffing of the heels, together with the tendons, vessels, and nerves passing through the sole of the foot. The upper surface of the horizontal process of cartilage is full of scabrous elevations and depressions that defy dissection, among which is found a quantity of gelatino-ligamentous tissue. Beneath, or to the under surface of this horizontal layer, the sensitive sole and bar are adherent. As it approaches the frog or center of the foot, it loses its cartilaginous nature and becomes coriaceous, or rather ligamento-coriaceous, in texture, agreeing in this with the internal frog.—(*Cyclop. Anat. and Phys.*)

The horizontal portion or process of the cartilage, known by veterinary writers as the *stratiform* process, is of greater thickness and substance than the other parts. It is also of coarser grain and more elastic nature. Both portions together communicate the general boundary of form to the lateral, posterior, and inferior parts of the foot. When the bars and the frog are thrust upward by pressure from without, they are acting against this same horizontal flooring formed by the cartilage and the frog, and are met by the depression of the bones of the foot forced down by pressure of the weight of the animal. The whole can then dilate exteriorly along with the posterior and more elastic parts of the hoof.

Several important purposes are answered by this extensive distribution of elastic fibro-cartilage—first, the interposition of a layer of elastic tissue between the hard hoof and the hard bone prevents shock and jar to the body as the foot strikes the ground in walking or running; secondly, the coffin-bone not extending posteriorly much beyond the middle of the foot, except by its projecting wings, a large portion of the hinder part of the foot is made up of soft elastic cartilage instead of bone, materially breaking the force of the blow of the tread; thirdly, the general distribution of elastic cartilage serves to equalize the pres-

---

* Fig. 17.—Section of the coffin-bone showing the numerous canals for blood vessels and nerves.

PLATE XI.

Fig. 7

Fig. 8

Fig. 9

Fig. 10

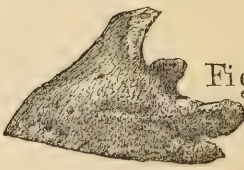


Fig. 11

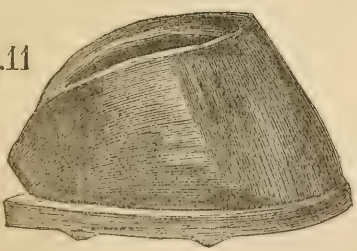


Fig. 12

Fig. 7. Splint bones.

Fig. 8. Pastern bone.

Fig. 9. Lower pastern, or coronet bone.

Fig. 10. Coffin bone.

Fig. 11. Side view of a nearly perfect hoof.

Fig. 12. Vertical section of the hoof, interior view, showing the horny laminæ.

sure of the bones of the foot upon the broader surface of the hoof; and, lastly, this arrangement of an elastic cushion, increasing in thickness toward the posterior aspect of the foot, affords an elastic support to the movements of the coffin-bone in the hoof, thereby aiding the elastic laminæ upon the superior convex surface in support of the bone. While the toe of the coffin-bone is comparatively stationary, there is considerable motion of the heel upon the toe as a center, thereby contributing to the extent, freedom, and ease of movement of the foot.

Molded upon the surface of the coffin-bone, over its entire extent, is a thick, villous, highly vascular, and sensitive membrane having the general name of the *sensitive foot*, besides having several local names derived from the part of the hoof under which it lies, as *sensitive laminæ*, *sensitive sole*, and *sensitive frog*.

This tissue is derived mainly from the skin. It may be said to be a process from the skin, covering the coffin-bone, and altered in its structure to adapt it to its office as an excretory membrane. It exactly corresponds to that portion of the human skin which produces the nails. The proper skin of the leg, as it arrives at the foot, becomes thickened and altered in its structure, constituting the mass around the summit of the hoof, to which veterinary writers have given the name of *coronary band*. This is lodged in a groove seen around the upper edge of the horny wall, and from this the straight fibers of the wall are secreted. From the coronary band there is a prolongation of the skin downward over the coffin-bone. This tissue is thrown into permanent folds or laminæ, the *sensitive laminæ*, between five and six hundred in number, arranged lengthwise of the foot. They secrete matter which enters into the formation of the horny wall, to the laminæ of which they are very closely united. According to Virchow, each lamina corresponds to a single papilla, as seen on the surface of the skin. Similar tissue, thickly studded with secreting papillæ, covers the inferior surface of the coffin-bone, the fibro-elastic frog, and the widely distributed cartilages, already mentioned. This tissue is richly supplied with nerves and blood-vessels, the latter forming large plexuses which extend to and above the margin of the hoof.

The elastic laminæ are found around the whole convex surface of the coffin-bone, having a breadth of about one-tenth of an inch and a length of about two inches in front, decreasing to an inch at the heels. These laminæ, much reduced in size and importance, are continued over the bars into the center of the foot. Each lamina consists of a single plait or fold of two layers of membrane, which apply closely to, and are firmly attached to, two corresponding surfaces of the laminæ of the horny hoof. Either in the laminæ themselves, or in the fibrous membrane on which they rest, and which is the medium of their union with the bone, great elasticity resides, so that the coffin-bone, with the weight it sustains, receives a large part of its support from the laminæ, acting as hundreds of elastic springs. It is this structure and arrangement that aid greatly in obviating shocks and preserving the integrity of the soft tissues at the bottom of the foot. By taking two strips of paper and folding them together in regular, even plaits, we have an illustration of the method of union between the soft and sensitive and the horny laminæ. If, in addition, one of the layers be considered elastic, the philosophy of the elastic suspension of the foot would be obvious.

The tissue constituting the sensitive sole, averaging perhaps one-eighth of an inch, thinner over the frog and thicker over the heels, is even more fibrous, vascular, and sensitive than the laminæ. It is closely connected with the fibrous tissue of the sensitive laminæ in front and the cover-

ing of the heels and frog behind. From it the horny sole and frog are secreted.

The sensitive tissues that invest the bones of the foot are covered and protected by a thick, dense, horny cap or box, *the hoof*. (Fig. 11.) The physiological relation of the hoof to the parts which it covers is essentially the same as that of the human nail to the parts covered by it. Functionally, its relations are more extensive and complete, and whatever differences exist in structure, in form, or extent of development, come from modifications for special use.

The hoof consists of three portions, which are so closely united as to seem but one; yet, by maceration, or by boiling, they can be separated. These are the *wall* or *crust*, the *sole*, and the *frog*.

The wall (Fig. 13,* *e*, *e*, *e*) is all that part of the hoof that is visible below the hair when the foot is placed upon the ground. It is in the form of a cylinder, cut across obliquely at the top. It is deepest in front, from three to four inches, and grows gradually less in depth toward its posterior aspect. This wall, which is secreted mainly by the coronary band, and partly by the sensitive wall beneath, is in front about half an inch in thickness, becoming thinner on the back side as it extends around the foot. It has an edge bearing upon the ground of about half an inch around the outside of the bottom of the foot. (Fig. 13, *e*, *e*.) Upon the inner side of the foot the wall is thinner than upon the outside.

The wall is divided into toe, quarters, heels, and bars, superior or coronary border, inferior or solar border, and laminæ.

Passing any special description of the borders, the laminæ deserve more particular attention.

The *laminæ*, or *lamellæ*, (Fig. 12,) are the very numerous, narrow, and thin plates which cover the entire interior aspect of the horny wall. They are in length from two inches in front to less than an inch at the heels. They are also visible over the bars. They have a very constant width of about one-tenth of an inch, and extend from the lower to the upper border of the hoof, are essentially parallel to each other, and have a free edge and two free surfaces. Each lamella is received into and is very closely united to two of the lamellæ of the sensitive wall. By this arrangement the surface by which the horny wall is attached to the sensitive hoof is very largely increased, (by exact calculation of Dr. Evans, increased by twelve times,) and this attachment, while possessing great strength, has great elasticity, and admits of considerable motion between the horny sole and the coffin-bone contained in it.

The *toe* (Fig. 13, *a*) constitutes about two-thirds of the wall, and is sometimes subdivided, for minute description, into toe, inner toe, and outer toe, (Fig. 13, *a*, a^1, a^2.) It is the deepest and thickest part of the wall, and stands at an angle, in the average of good feet, of about forty-five degrees. When the angle of inclination is much greater than this, the feet are designated as flat and weak. Flat and weak feet usually obtain in large and heavy animals, and it has been thought that the foot is flattened, the anterior wall drawn down, by the weight.

The quarters (Fig. 13, b^1, b^2) are the portions on each side, midway between the toe and the heels, and are designated as the inside and outside quarters. The fibers composing them run obliquely upward

* FIG. 13.—Ground surface of hoof, from Miles: *a*, toe; *a* 1, inner toe; *a* 2, outer toe; *b* 1, inner quarter; *b* 2, outer quarter; *c* 1, inner heel; *c* 2, outer heel; *d*, *d*, *d*, sole; *e*, *e*, wall of the hoof; *f*, *f*, the bars; *g*, *g*, the commissures; *h*, *k*, *l*, the frog; *h*, part under the navicular joint; *k*, boundary of the cleft; *i*, *i*, the bulbs of the heels.

PLATE XII.

Fig. 13

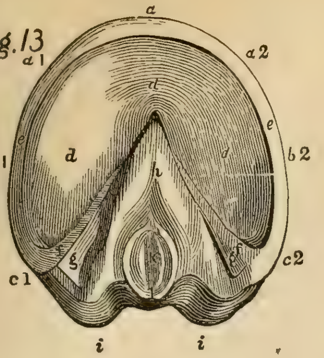


Fig. 14

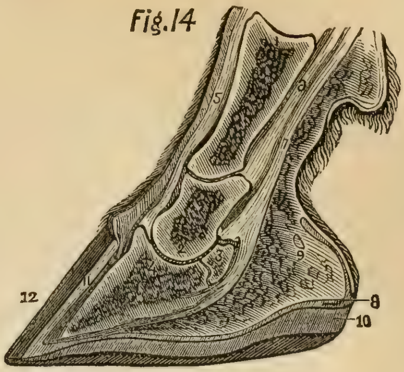
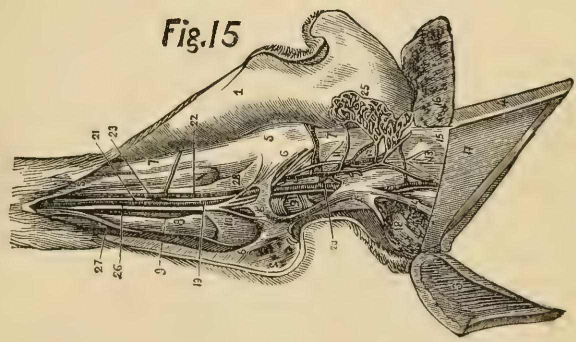


Fig. 15



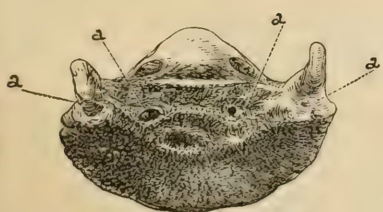


Fig. 16

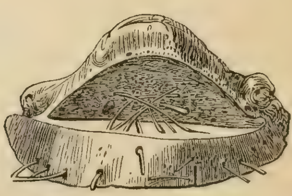


Fig. 17.

Fig. 13. Ground surface of hoof.
Fig. 14. Vertical section of horse's foot.
Fig. 15. Dissection of horse's foot.
Fig. 16. Posterior view of the coffin bone.
Fig. 17. Section of the coffin bone.

and backward, parallel to those of the toe. The quarters slope downward and backward, and become thinner as they approach the heels.

The *heels* (Fig. 13, *i*, *i*) are the two protuberant portions of the wall by which it is terminated posteriorly. The wall here is shortest and thinnest, the fibers being only about an inch in length, and not exceeding the fourth of an inch in thickness. While, in its natural state, there is some degree of elasticity in the entire wall, there is much more in the portion that covers the heels.

The *bars* (Fig. 13, *f*, *f*) are reflections of the wall in toward the center of the foot, on its ground surface. They gradually approach each other, and come together a little in front of the center of the foot. The bars are usually regarded as parts of the sole, but maceration shows them to be separable from the sole, but inseparable from the wall. In the natural, healthy foot, that has never been shod, the bars appear as sharpened prominences, like braces, between the center of the foot and the heels. The best writers agree that they are well adapted to keep the heels open, and prevent contraction of the hoof. In the unshod foot, the bars have a bearing upon the ground, second only to that of the edge of the wall.

The *sole* (Fig. 13, *d*, *d*, *d*) fills the space between the wall and the bars. It is in the form of an irregular arched plate, the concavity being toward the ground. It is firmly attached, by its outer convex edge, to the inner surface of the solar border of the wall, while its inner straight edges are attached to the bars. It has been described as joining the frog, but throughout its whole extent the bars intervene between the sole and the frog. The center of the sole is the thinnest portion of it, and it also constitutes the summit of the arch. The lower circumference of the arch, which is also the thickest and strongest, everywhere abuts against the sides of the wall. The result of this mechanism is, that at every step, as the weight is thrown upon the foot, the coffin-bone descends, elongating the elastic fibrous tissue connected with the sensitive laminæ, and, pressing upon the highly elastic tissue of the sensitive sole, which rests upon the arch of the horny sole, causes the latter to yield and descend. The wall being elastic, especially toward the heels, is readily pressed outward, so that the ground surface of the foot is larger while bearing the weight than it is when the pressure is removed. Whenever the weight is taken off, the wall springs back, and the sole recovers its arched form. By this means the step is rendered elastic, jarring is obviated, and injury to the sensitive sole and sensitive frog is prevented.

The frog (Fig. 13, *h*, *k*, *l*) is a wedge-like mass filling the angular space between the bars, and consists not of solid horn, as might at first seem, but of a series of elastic arches. It has been not inaptly compared to an elastic keystone received into an elastic arch, communicating in some cases, and admitting in all, the springing movements of which such an arch is capable. The base of the frog lies between and connects the posterior curved portions of the hoof, limiting to some extent their action. The sides are connected with the bars by their upper edges, leaving upon the ground surface two deep channels between the lower border of the bars and frog, which have been termed the commissures of the frog. (Fig. 13, *g*.) The horny material arching over these channels is called the *arch of the commissures*. In the center of the frog, as we look upon its ground surface, is a deep, narrow depression, *the cleft of the frog*, (Fig. 13 *k*,) which extends farther into the soft tissues of the foot than the commissures. This cleft is arched over in a similar manner; and the cone-like mass, as viewed on its inner upper surface, has received the name of *frog stay* or *bolt*.

Looking upon both the exterior and interior surface of the frog, we see that with the bars it forms three elastic foldings, which act as springs to keep the heels apart and the foot well spread. In the natural, unshod foot, the frog, though protected to some degree by the solar border of the wall and by the sharp prominences of the bars, must still receive pressure at each step. The order of force in which the different parts of the foot press the ground in walking, running, &c., has been stated to be as follows: First, the solar border of the wall; second, the bars; and third, the frog. In the foot that has never been shod the frog has nearly if not quite as much pressure in the full step as the wall. In rapid stepping, the edge of the wall, which is nearest the point of the coffin-bone, receives the first force of the blow, while the frog, which mainly rests upon the elastic heels, a much more yielding substance. receives the weight as the foot settles back to its level. The effect of pressure is to flatten the arches of the commissures and cleft, to widen the frog, throw out the heels, and keep the foot freely expanded.

The elasticity of the step of the horse is the result of a highly compound arrangement—first, the elasticity of the sensitive laminæ; second, the greater elasticity of the sensitive sole; third, the elasticity of the horny wall; fourth, the arch of the sole; and, fifth, the triple spring formed by the foldings of the frog and the manner of its union with the bars.

The movements of the foot are produced by two sets of muscles, *flexors* and *extensors*, similar to the distribution of a single finger in man.

The *flexors* are two in number, and are situated upon the posterior aspect of the leg. In the fore legs these muscles are the *flexor sublimis perforatus*, (Fig. 14, "6,") and the *flexor profundus perforans*, (Fig. 14, "7,") also called in works on farriery *flexor pedis perforatus* and *flexor pedis perforans;* also familiarly designated as the *common* and *deep flexor muscles*. These muscles take their origin in common from the internal protuberance of the humerus, and are united for a considerable distance down the arm, when they separate to form two distinct tendons. Of these, that belonging to the perforatus runs beneath the annular ligament of the carpus, to be inserted into the upper and back part of the lower pastern or coronet bone. Just before reaching the pastern joint, this tendon divides, to allow the tendon of the perforans to pass through it. Each division where it plays over the joint has in it a sesamoid bone.

The tendon of the *perforans*, lying deeper above, passes between the divided tendon of the first-named muscle, to be inserted into the posterior concavity of the coffin-bone. Attached to this tendon, as it passes over the joint formed by the coronet and coffin-bones, is the navicular bone, considered as a sesamoid bone in this tendon. Two supplementary flexors, the *accessorii*, are described as arising from the posterior and inferior aspect of the ulna and the radius, and uniting below with the two main flexors. These muscles flex the foot upon the leg. As antagonists to these, there are three extensor muscles situated upon the front of the leg, corresponding to the *extensor communis digitorum* and *extensor minimi digiti* of the human arm.

The *extensor communis*, otherwise called in hippotomy *extensor pedis*, arises from the external condyle of the humerus, and from contiguous fascia, and from the upper and lateral part of the radius, and has a strong, fleshy belly, which terminates in a single tendon which passes down over the front of the leg to be inserted into the coronal process of the last phalanx—the coffin-bone. It unites by a slip with the tendon of the next muscle. The *extensor proprius minimi digiti* is represented

in the horse by two muscles. One of these, called the *extensor of the pastern*, is inserted by a strong tendon into the side of the first phalanx, the pastern-bone. The second muscle, placed between the two preceding muscles, furnishes a strong tendon which passes down in front of the carpus and becomes united with the *communis* at an acute angle. The united tendon (Fig. 14, "5") passes behind the coronary border of the hoof to its insertion in the coffin-bone. The office of these muscles is to extend the foot upon the leg. Another muscle, the *adductor longus pollicis*, called in hippotomy the *oblique extensor of the cannon*, by its insertion into the base of the cannon-bone, acts as an extensor of the foot.

A similar arrangement exists in the muscles of the hind leg. The tendon of the *plantaris*, of great strength, has a divided insertion corresponding to that of the *flexor sublimis perforatus* of the fore leg, while the *flexor perforans* sends its single strong tendon between the two divisions of the preceding muscle to be inserted into the terminal phalanx. These flexors of the foot are assisted by the tendon of the *flexor hallucis*, which unites with the tendon of the *perforans*. The extensor tendon of the hind leg, of great strength, is furnished mainly by the *extensor communis* muscle. The *extensor brevis* is represented by a few fibers which come from the cannon-bone, and unite with the tendon of the *communis*. The united tendon passes, as the corresponding one of the fore leg, (Fig. 14, "5,") to its insertion in the coffin-bone.

The arteries of the foot are branches of the *radial*, in the fore, and of the *tibial* in the hind legs. The former descends along the radius, accompanied by the radial nerve, to a point a little above the knee, where it divides into the large and small metacarpal arteries. Of these the large metacarpal is the principal trunk, passing under the posterior annular ligament. While passing down the cannon-bone it divides into three branches. The middle one is distributed to surrounding tissues, while the other two become the *plantar arteries*, *internal* and *external*. The plantar arteries of the fore leg result from a division of the *metacarpal*, and in the hind leg from a similar division of the *metatarsal*, and the terminal distribution is alike in both. They descend to the lower part of the cannon-bone, (Fig. 15*, "19," "20," "21,") pass the fetlock joint by the side of the sesamoid bones, in company with veins and nerves of the same names, and pass into the substance of what is sometimes called the fatty frog. They then pass the extremities of the coffin-bone and enter the foramina on the posterior concavity of the bone. (Fig. 16, *a*, *a*, *a*, *a*.) The branches of the plantar arteries are very numerous, and no part of the body is more fully supplied with blood than the foot. (Fig. 17.)

The veins of the foot constitute a very intricate net-work of vessels. The veins of the frog, the sole, the laminæ, the superficial and deep-seated coronary veins, unite to form coronary and plantar plexuses, (Fig. 15, "25,") from which are formed plantar veins, (Fig. 15, "22," "23,") which, by their union, constitute metacarpal and metatarsal veins, which lie anterior to, and by the side of, the plantar arteries.

* FIG. 15.—Dissection of the horse's foot. From Owen: 1, general integument, turned back; 2, fatty mass, forming a cushion behind the great pastern joint; 3, wall of hoof turned back, showing the vertically laminated processes projecting from its inner surface; 4, section of wall of hoof; 5, the articulation between the cannon and pastern bones; 6, 6, 6, aponeurotic tissues; 7, 7, extensor tendon of the foot; 8, 9, 10, flexor tendons of the foot; 11, 12, 13, 14, 15, expansion of the great cartilage of the foot; 16, the coronary band raised from the hoof; 17, the vascular or sensitive hoof; 18, elastic cushion of the heels; 19, 20, 21, plantar artery; 22, 23, plantar veins; 25, part of coronary venous plexus raised from its position; 26, 27, 28, plantar nerves.

The nerves of the foot are known by names corresponding to those of the blood-vessels which they accompany. The *plantar nerves* (Fig. 15, "26," "27," "28") lie by the side of and behind the corresponding artery, and, as they descend into the foot, are distributed to the same organs and regions. The final branches enter the foramina in the coffin-bone, minutely subdivide in it, pass through its many canals, and escape at the edges of the sole to the sensitive parts of the foot, in company with the terminal twigs of the arteries. (Fig. 17.)

DISEASES OF THE FOOT.

The most practical division of this subject is based upon the structures affected, so that we may have diseases of the bones, of the joints, of the soft tissues, and of the hoof. A large portion of these are inflammations or the results of inflammation.

Original inflammation of the bony tissue is comparatively rare, while that of the periostial investment of the bone is quite frequent. A variety of causes may account for this. Perhaps the most common is the evil of overwork. Hard driving on a hard road, as on a plank road, on the frozen ground, or on the ice, or the strain of draught at too heavy a load, may excite periostial inflammation, and from this as a commencement we may have splint, spavin, ring-bone, nodes, &c.

Splint (Fig. 18) is a bony tumor at some point about the cannon and splint bones. The *knee-joint* is formed at its inferior part, between the lower row of carpal bones and the cannon and splint bones, the two latter forming a considerable portion of the joint. As the leg is flexed these bones slide upon the cannon-bone, contributing to the elasticity of the step. When the motion is violent and long continued, especially with striking upon a hard surface, irritation first and inflammation afterward may be produced in the periostial membrane covering these bones. Bony matter is thrown out in the immediate vicinity of their adjacent surfaces, and the result is a sealing together of the bones and the formation of a bony tumor. Unfortunately the condition is frequently overlooked until the change is complete and the disease beyond a remedy, for when the bony union is thoroughly consolidated it cannot be remedied. For a time, while the deposit is fresh callus, and the circulation active, measures to abate the inflammation and to excite the absorption of the deposit may restore the integrity of the part.

Ringbone, (Figs. 19 and 20.)—In the pathology of the disease splint and ring-bone are the same. They have the same causes, and are preceded by the same stages of morbid action; but, from the relation of parts, ring-bone, at its forming stage, gives rise to earlier and greater lameness. Attention is earlier called to the disease, and treatment is usually sooner applied. Splint may go on to its final stage of bony consolidation without giving rise to much lameness, and without attracting attention to the diseased part, which may escape observation unless the hand is passed over the small tumor; but in ring-bone usually the lameness appears with the inflammation, and the earliest effusion over the region calls attention to the seat of the disease.

Spavin, (Figs. 21, 22, 23, and 24.)—When it consists in the deposit of bony matter about the hock joint, and the consequent cementing together of the tarsal bones, or the destruction of the tarso-metatarsal joint, is a similar disease, having essentially the same causes. This form of disease may exist in every degree, from a slight exostosis near the joint to such an amount as will entirely destroy the joint, and so invade the soft tissues that the slightest movement is productive of great suffering.

PLATE XIII.

Fig.18.

Fig 19.

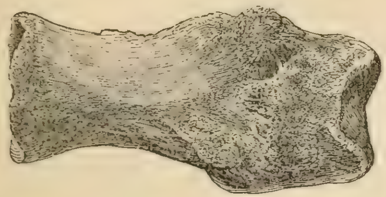


Fig.20.

Fig.21.

Fig.23.

Fig.22.

Fig. 18. Cannon bone with splint; *a* the splint.
Fig. 19. Pastern and coronet, showing ring-bone.
Fig. 20. Pastern bone, showing commencement of formation of ring-bone.
Figs. 21, 22, and 23. Spavin.

Treatment.—Cure or alleviation is possible only in the first stages of the disease, so that on the occurrence of lameness for which the cause is not obvious, careful search should be made in the localities in which splint, ring-bone, or spavin may occur. Tenderness and perhaps swelling may be detected by careful examination. The first requisite is *rest*. Bathing with warm water should be promptly and perseveringly resorted to. The foot should be put into a bucket of warm water, which should be applied with a sponge to the locality of inflammation. Should there be pain, as shown by general uneasiness and constant movement of the limb, a poultice should be applied, moistened freely with a mixture composed of equal parts of the tinctures of aconite root, opium, and belladonna. The application of a mixture of one part chloroform and two parts sweet-oil may act as a revulsive. Later, when the pain has subsided, the tenderness somewhat abated, and only swelling remains, an ointment of one part of the iodide of lead with eight parts of lard will be found useful in removing the swelling and remaining engorgements of the parts. When put again to use, the animal should be at first gently exercised and brought gradually to his work.

The abuse in driving, which gives rise to periostitis and the deposition of bone about the joints, may result also in ulceration of the cartilages and bones entering into the composition of the joints. The parts most usually affected are the knee, the hock, and the joints of the navicular bone, with the coronet or coffin-bone. The commencement of the disease is an inflammation of the synovial membrane which lines the bony surfaces between which the motion of the joints occurs. Prolonged lameness follows. Perfect rest at this time with proper treatment may remove the condition, but by neglect, and continued use, the disease is readily carried to its advanced stages. The inflammation extends to the cartilages covering the joint-surfaces of the bones. The vitality ot this tissue is so low that it readily breaks down under the inflammatory action, and is removed by the ulcerative process. From this condition perfect recovery is impossible. The best result possible is the formation of a blind spavin, by the cementing of two opposite surfaces of bone by an intermediate bony deposit. Instead of this, the ulcerative process may extend to the bony tissue itself. In Fig. 25 may be seen this ulcerative disease as it invades the navicular bone.

That disease of the *navicular bone* may and does exist is undoubted, as witness the two diseased bones in Fig. 25, but that it is one-tenth part as frequent as some claim admits of great doubt. Navicular disease, like "*shoulder lameness*," has been made to answer all obscure causes of lameness. Except as a constitutional disease, it can only occur, under any ordinary circumstances, in a wide-spread and flat foot. In ordinary forms of the coffin-bone it is raised so high above injury that one can hardly conceive it to happen from this cause alone. The only condition from which it can ordinarily arise is inflammation of the synovial membrane. This *may* be excited by a bruise, communicated through the sensitive sole and frog, and also the tendon of the perforans. It more frequently occurs, however, as the result of violent and long-continued movement, as in fast driving over long distances; and even in this case there probably exists a constitutional disposition to disease. The disease is one fruit of inflammation of a low grade, terminating in ulceration of the cartilage, and finally of the bone. It in no way differs from ulceration of the bones in other joints except in its termination. Being on the under surface of the bone on which moves the tendon, it cannot recover by becoming cemented to a fellow-bone; so that it is doubtful whether navicular disease, when it has proceeded to the extent

of ulceration of the bone, ever recovers. Treatment in the earlier stages, by rest, by foot-baths, by tonic and alterative medicines, and by good, nutritious food, may arrest the disease and restore health to the part.

There is another form of disease which is produced by the irritation of hard driving upon a hard road-bed, or by the constant strain of moving heavy loads, and especially in heavy horses. I refer to the ossification of the cartilages of the feet. (Fig. 26.) During the transformation from cartilage to bone, any unusual exercise may produce some degree of lameness. Fullness, heat, and a doughiness of the part may be detected by careful manipulation. Later, in place of the soft, elastic feeling of the healthy foot, we find the solidity of bone. As the change becomes complete, there is but little direct lameness, but the part becomes stiff. The animal is unfitted for the saddle and rapid driving, but may still be useful for draught. Before the bone is fully formed, and especially during the earlier stage of inflammation, the trouble may sometimes be prevented. The measures to be adopted are similar to those previously mentioned—rest, abundant warm-water bathing in the earlier stages; stimulating friction, and the use of the iodide of lead ointment in the later stages.

Of the affections of the soft tissues, perhaps the most common is *laminitis*. This term applies to inflammation not only of the laminæ but of the entire fleshy portion of the foot. It is not always the most readily detected, and in some of its more common and milder forms it entirely escapes notice. The lameness is assigned to the shoulder or some other locality; but when we refer to the position of this tissue, between a dense bone and a dense unyielding horny envelope, and to its use to suspend the bone and consequent entire weight of the animal from the wall, and consider that it suffers some degree of pressure at every step, we can understand how the slightest morbid condition of the part, the congestion of its vessels, or irritation of its nerves may—nay, must—give rise to pain and consequent lameness. Fortunately, in practice this is much less frequent than, theoretically, we might expect it to be. Any horse that has been driven for several hours upon a hard, or stony, or hot and sandy road would seem to be fairly fitted for some degree of congestion of the soft tissues of the feet. At the close of such exertion he is stabled, perhaps upon a damp floor, or where a draught of air may blow upon him. No thought is given to the condition of his feet. He is fed, and perhaps he may have been moderately groomed; but of the entire animal no part has undergone so much exposure or hardship as the feet, and no part really needs so much attention.

Laminitis, or, as it has been called by writers, *fever of the feet*, or "*founder*," may exist in all degrees, from the simple congestion of the part to the most severe and disorganizing inflammation. It is mainly exhibited in the fore feet, being an uncommon disease in the hind feet. This is mainly due to the different kinds and degrees of force used in the action of the fore and hind legs and feet. In movement a much greater amount of weight comes upon the fore legs and feet, the direction of the blow upon the ground is different, and the consequent strain and pressure upon the soft tissues much greater.

If acute laminitis is present in one or both fore feet, it is manifested by the very obvious efforts of the animal to relieve itself from pressure. If one foot only is suffering, this is put forward and is so rested upon the heel that not only is pressure taken off, but the parts are relaxed to a still greater extent by the weight of the limb. At the same time, the foot is kept in continual motion, indicating extreme pain. There is heat

PLATE XIV.

Fig. 24

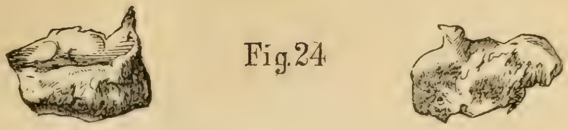


Fig. 25

Fig. 26

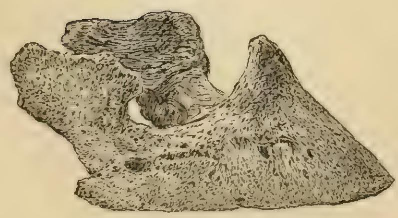


Fig. 24. Spavin, the lower tarsal bones cemented by bony deposit.
Fig. 25. Navicular disease; ulceration of the bone.
Fig. 26. Coffin bone, side view, showing ossification of the lateral cartilages.

in the hoof, and especially in the coronary band around its summit. There may also be tenderness in this tissue on pressure. If both fore-feet are affected, the animal endeavors as far as possible, by settling back over the hind feet, to take off the pressure from them. This attempt may also be shown by the continuous change from one foot to the other. In severe forms of the acute disease the entire system will sympathize with the local disease. The arteries supplying the part or parts will be found throbbing; the general arterial circulation will be quickened; the pulse will become considerably accelerated, and the constitutional condition will be one of symptomatic fever.

The disease if unchecked may go on to the destruction of the soft tissues of the foot. Cases are on record in which the entire hoof has been shed by the separation of the soft from the horny foot. This is a rare termination, but the formation of an abscess and partial separation is not so uncommon. Before this result occurs, however, the disease has usually passed into the chronic form. Prompt resort to appropriate treatment may result in restoration to health.

By no means advocating indiscriminate blood-letting, we would in this case recommend the free local abstraction of blood, either from the toe of the afflicted foot, or from the plantar vein. If the case is a very severe one, a branch of the plantar artery of one side may be divided. The foot should be placed in a large bucket of warm water, and allowed to bleed in it. Care should be taken to keep up the temperature by frequent additions of hot water. When the foot is removed, it may be placed in a large poultice, having previously been drenched about the coronary border with a liniment composed of two ounces each of the tincture of aconite root, belladonna, and opium, with six ounces of soap liniment.

For the constitutional disturbance, the tincture of aconite root, fifteen to twenty drops in water, may be administered every hour or half hour until a decided impression is made upon the frequency and hardness of the pulse.* Later, saline medicines, such as the nitrate of potash, will aid in preventing secondary affections.

Laminitis may have a variety of terminations. First, it may terminate in a complete disappearance of all the symptoms, that is, by resolution, and there be a complete recovery. Second, it may pass into a chronic condition in which all the symptoms are of a mitigated character. When quiet, the pain is slight, and the heat is little, if any, in excess of the natural state. If the animal is allowed rest upon a soft floor, or is turned to run in a paddock, the lameness may be scarcely obvious; but attempt to drive him, and, either while on the road or afterward, he becomes very lame again. This condition may continue almost indefinitely. Third, the inflammation may terminate in suppuration, which may be confined to a small region of the foot, and eventuate in a partial recovery, or it may be general and so extensive as to destroy the connection of the hoof with the soft tissues. Under the latter circumstances the hoof may be lost. When the destructive suppuration falls short of producing complete separation, it may be sufficient to permit of a change of relation of the coffin-bone to the hoof. A portion of the anterior attachments may be destroyed so that the bone may fall away from the horn. In a flat and weak foot this may cause a bulging of the sole, producing what is called the *pumice foot.* If the hoof is preserved, the space produced by the falling of the

* Half a drachm of belladonna with fifteen grains of digitalis may be given every half hour, or in emergency the following draught may be given every hour until the proper impression is made on the system: Tinct. aconite root and tinct. belladonna fifteen drops each, and sulph. ether and laudanum half an ounce each.

coffin-bone is filled by fleshy granulations. The foot, however, suffers permanently, and lameness is constantly present.

Such is the structure of the foot that, even when the damage is less than that just described, the suppuration continues and burrows in various directions, seeking an outlet. Except when the inflammation and suppuration are confined to a limited space in the sole of the foot, the discharge must escape from the crown. At some part of the coronal border of the hoof, swelling is perceived, which either opens of itself or is opened by the knife, which is preferable. When suppuration has commenced, the animal should receive better and more nutritious food, while stimulating injections to the opening may be useful. Should the sinuses become chronic, it has been recommended to trace their number and direction with a delicate probe, and then freely lay them open. To do this, the hoof must be softened by soaking in warm alkaline water, when it may be cut easily.

Limited suppuration of the soft tissues of the foot may occur from a variety of other causes, such as a wound made by the shoe of one foot in the coronet of the other, or by the prick of a nail driven into the quick or so near it as to cause inflammation by pressure, or by a bruise made by the heel of the coffin-bone, to which the term *corn* is applied. In all these cases suppuration may follow inflammation, and the severity and extent of the trouble will depend upon the locality of the injury, and the distance the product of suppuration has to travel to reach a point of exit.

A fourth termination may be designated—that by *metastasis*. The inflammation being situated in the fibrous tissues of the foot is liable to leave that locality and to seize upon similar tissues elsewhere, and under unfavorable circumstances we may have resulting inflammation of the brain or pleura, or indeed of any of the fibrous tissues. A fifth termination may be in mortification, the result of which would be almost certainly fatal at an early period.

Laminitis may be *sub-acute* from its commencement. It is apt to take this form in old horses that have been subjected for a long time to hard work. Its approach is gradual, pain at first small, and lameness slight and not constant. The foot should be given the same treatment as in the more acute form. The warm bath should be used freely. Bleeding would probably be injurious, and any debilitating medicines must be withheld. The bowels may be loosened by fresh vegetable food, such as potatoes or carrots, and if pain is present one or two draughts in the day containing an ounce of sulphuric ether and a drachm of laudanum may be given. Plenty of good, nutritious food should be given. The horse should not be used on the road until all the symptoms have been absent for several days. He may be gently exercised on a soft sward as soon as the inflammation is subdued.

A permanent, incurable lameness often results from the continued use of a horse suffering from some degree of inflammation of the soft tissues of the foot. Whenever this condition is detected, the animal should be given rest, and subjected to treatment with a view to the *cure* of the disease.

We have spoken of a limited suppuration with sinuses between the hoof and the coffin-bone as the result of injury to the coronet, the prick of a nail, or a bruise, which form an abscess at the crown of the foot. To certain abscesses in this region, resulting from an ulceration of the deeper-seated cartilages, the term *quittor* has been applied. The local condition on which this disease depends differs widely from that causing a similar discharge in a healthy foot by direct injury. *Quittor* is a deep-

seated lesion of the foot, seated in the cartilages, or perhaps even in the coffin-bone itself. It may follow the inflammation of injury, or it may originate in constitutional conditions. Neglected corns, increasing by continued bruising, may cause by pressure the ulceration and mortification of the cartilage, or even of the bone. Fracture of some part of the coffin-bone may eventuate in this disease. It rarely gets well without assistance. When it is diagnosticated, a well-informed veterinary surgeon should be called. The treatment is mainly by local injections, aiding nature to discharge the product of ulceration and stimulating to healthy granulations. Of course the animal is utterly unfit for use.

We have spoken of *corns*. These make their appearance in two forms, the *true* and the *false*. The locality of the true corn is the angle caused by the inflection of the bars, and is between the bars and wall. In this space the posterior extremities of the coffin-bone move freely in the movements of the foot. By the irritation of frequent, prolonged, and severe use, a thickening of the laminæ is produced. This hardens and ultimately becomes a semi-corneous tumor. It may remain in this condition, or it may become a smooth, dense horn, more dense than any part of the hoof. It is a constant source of pain and consequent lameness.

The more common *false corn* is a bruise of the sensitive sole which lies directly under the heel of the coffin-bone. This occurs most frequently in feet having a flat, level sole, deficient in the arch. It may occur in any variety of foot which is kept badly shod. A shoe with a broad web level upon its foot-surface, and seated for its whole width upon the wall and sole, will aid in the production of this form of disease. Several varieties of the false corn are described, but they are simply different stages of the same disease. The *true corn* is essentially incurable. For the *false*, in its early stages the general principles of treatment to abate local inflammation may arrest the disease. If suppuration can be prevented, the duration of lameness will be much limited. Care should be taken that the shoe should have its bearing only on the solar border of the wall, and a very slight portion of the outer border of the sole. To this end, a shoe should be used with a narrow web, but little over half an inch in width; or the shoe with a wider web should be seated so that its bearing-surface would be narrow. Supposing the case has been neglected and suppuration has occurred, the pain and lameness will be great until the matter is evacuated. The sole must be carefully pared away until the horn is very thin, when an opening must be made through it, and the pus evacuated. If great pain is inflicted by the attempt, the foot should be soaked in a warm alkaline bath, by which the horn will be softened, and the extreme tenderness abated. If possible, the foot should be kept in a poultice for a day or two, or three, according to the previous severity of the disease. After that the shoe may be reapplied, care being taken that the opening through the horn be so protected that no dirt or gravel can enter.

A condition similar to false corn may exhibit itself in any portion of the ground surface of the foot as the result of a severe stone-bruise. If detected early, the warm foot-bath, with rest, will be sufficient treatment for it.

One of the most common of the diseases of the foot bears the popular name of *thrush*. Of its exact nature and locality perhaps no two hippopathologists agree. Mayhew, Youatt, Spooner, and others characterize the disease by one of its symptoms, and speak of it as "an offensive discharge from the cleft of the frog," to which is sometimes added "with disorganization of the horn." Both these are symptoms of the real disease, which is a low form of inflammation in the soft

tissues of the sensitive frog. It exists in feet that have been allowed to stand in damp, ill-cleaned stalls, where they are continually covered with wet manure. Running in a wet yard predisposes to it. Gamgee describes *thrush* as "a diseased condition of the villous membrane covering the frog," and says that it is, in its usual form, produced by filth and neglect.

The true seat of the disease is, we believe, in the superficial and less fibrous tissues of the sensitive frog. It is doubtful if true inflammation is present. Pain is usually present in inflamed tissues, and thrush is to a remarkable degree a painless disease. One of the properties of the sensitive frog is to secrete the tissue that becomes the horny frog. Now if, by reason of local or constitutional debility, the secretive action of the part is imperfect; if the secreted matter, lacking vitality, instead of producing horn breaks down into pus, or pus mingled with half-formed and decomposing horn; we should get just the condition we have in thrush.

In the healthy frog the cleft is so perfectly covered over by an arch of horn that fluid could escape only through an artificial opening; but in this diseased condition, the horn is both in so imperfect a state from defect in its original secretion, and so disintegrated by the direct influence upon it of the diseased secretion, that the offensive pus escapes freely from it.

It has been claimed that contracted feet, and too great and long-continued paring of the frog, are the main causes of this disease. They undoubtedly predispose to it, as they contribute, by change of the form of the foot, to affect a change in the nutrition of the organ. But thrush is seen, perhaps, in a well-spread, open foot as frequently as in a contracted one. Constitutional condition has much to do with the local manifestation. An animal poorly nourished and cared for, other things being equal, will be more likely to exhibit the disease.

Any treatment that loses sight of the constitutional condition will fail to do its best work. First of all, the horse should be placed in a stall having a dry floor, or on a short and dry sward, covering a warm, sandy soil. Then he should have thoroughly nutritious diet, and, if the disease has been of long standing, alterative and tonic medicines may be given. Red bark, sulphuret of antimony, and niter, in the proportion of two parts of the first to one part each of the last two; or a ball, consisting of a quarter of a grain of strychnine, half a drachm of iodide of iron, half a scruple of extract of belladonna, and extract of gentian and powdered quassia sufficient to make it, may be given night and morning. The foot should be put into a bath of warm water and thoroughly cleansed; all dust and pus should be carefully removed from the commissures, and the part dried by the use of dry tow. Then into the crevices should be poured, once a day, a little of a solution of the chloride of zinc, (three grains to the ounce of water). The foot is to be kept shod with calkins, so that a free space may be left under the foot for the circulation of the air. Cases will yield more readily to simply constitutional than to simply local treatment. A judicious combination of the two will have the happiest results.

The condition of *thrush* neglected may pass into that of *canker*. *Canker of the foot* may be an original disease in low-bred, ill-conditioned horses, exposed in wet or filthy stables or yards, and poorly cared for. It more frequently, however, follows thrush which has been neglected. It commences in the same tissues, rapidly extending from the frog to the sole and the laminated structures. The disease consists in destructive inflammation, with ulceration, which destroys the connection between the

sensitive and horny sole and frog. After a time a foul fungus sprouts from the ulcerations, accompanied with exceedingly disagreeable discharge. The horn of the sole and frog becomes disorganized, and breaks down. The fungoid granulations, with the constitutional depravity which predisposes to them, constitute the disease.

The treatment consists in the removal, by the knife, of all the detached horn, together with as much of the fungoid tissue as can be removed without the loss of too much blood, and the application of astringents and mild caustics, so applied as to remove the remaining fungus and to change the action of the part. Constitutional treatment, tonics, and alteratives, with good care and nutritious food, will do much in causing a successful issue.

It is believed that much of the obscure lameness to which horses somewhat advanced in years, and especially those that have had much severe driving and work, are subjected, is *rheumatic*. From the nature of the tissue composing the sensitive foot, so largely fibrous as it is, we might anticipate that from long-continued hard usage there would arise a degree of irritability in that tissue that would cause lameness. This condition must not be confounded with acute rheumatic fever, to which horses are sometimes subject, and which is a different disease. The disease of which I speak in this connection is an irritability and painful condition of the fibrous tissue, without any of the products or results of the inflammatory action.

The animal should be housed in a dry and airy stable, but sheltered from draughts of air, and should be blanketed. The feet should be treated to a warm bath, and then be rubbed dry, and have an application of Fahnestock's liniment, and be bandaged. At the same time there may be given daily in meal an ounce of acetate of potash, with a scruple of powdered colchicum; or a draught of the following: iodide of potassium, two ounces; liquor potassæ, one quart; of which two tablespoonfuls may be given, night and morning, in a pint of water or mixed with feed.

There are several diseased conditions which manifest themselves in the horny foot. Of these the most important are the flat or convex sole, or the pumice-foot, and the sand-crack. The false quarter is in no very great degree different from the sand-crack. All disease or malformations of the horn must originate in injury or in disease of the soft tissues from which the horn is a secretion.

The pumice-foot, which consists in a falling of the sole to a level with the solar border of the wall, or even so as to constitute a convex surface, is usually preceded and caused either by a destruction of the elastic laminæ attaching the coffin-bone to the horn, or to an elongation of the same, or else to a softening, spreading, and flattening of the entire hoof. Animals with natural flat feet—those that have been bred on marshy land, where their feet have been kept soft, are most liable to exhibit this form. Probably nothing can restore this kind of foot; but care in shoeing may enable the animal to be of some service.

Sand-crack is a fissure in the hoof, which begins at the coronet, the thin edge first breaking away. It is a disease of nutrition, the horn of the foot being secreted in diminished quantity and impaired quality. The break, small at first, is extended until it may divide the entire hoof. It usually occurs in the *quarter*, and perhaps most frequently at the inner quarter. It has been asserted that the whole difficulty is produced by bad shoeing. Low condition, impure state of the blood, and lack of care are predisposing causes. In this conjuncture slight injury to the

coronet may be followed by such deficient secretion of horn at that place, that the weakened part may give way and sand-crack take place.

If possible, the animal should be given entire freedom from work, and should be turned into a small paddock, or have a loose box, in which he may move somewhat. He should have nutritious food, and sufficient green food or bran mash to keep his bowels free. During the early stages of the disease, and while efforts are being made to restore the soundness of the foot, the horse is better without shoes, as the natural movements of the parts tend to restore their vitality. The bar-shoes, recommended by some writers, are useful only in those cases of long standing which are essentially incurable, and where the horses are to be put to slow work. The part should be interfered with as little as possible; there should be no cutting, paring, or burning; and care should be taken to keep dirt, gravel, &c., from the open sore. The healthy condition of the open and granulating surface should be maintained by frequent washing with soap and water, and the application of the solution of chloride of zinc, (three grains to the ounce of water.) If the animal is in use, before being taken out the crack should be filled with lint saturated with the solution, which should be confined in place by a strip or cloth completely covered with tar. This should be removed as soon as the horse returns, and the wound be cleansed, if it is at all foul, and carefully dressed again. If treatment is commenced early, a fair degree of expectation of recovery may be entertained; but, in many cases, through neglect or lack of proper treatment, a permanent deficiency of the hoof remains. In such cases, by the use of a bar-shoe, properly adjusted, the animal may be made of some use.

Contraction of the horn of the foot is a frequent cause of lameness. This may occur at some part of the coronary border, or may be in the quarters, or may be confined to the heels; the last being, perhaps, its most frequent locality. Contraction at the cornorary border produces lameness mainly by pressure on the extensor tendon. Movement produces irritation and consequent pain, which is shown when the animal is at rest by his putting the foot forward. This position relieves the pressure upon the tendon, and gives partial relief from pain. Contraction at the quarters and heels may not always cause lameness. If the condition comes on very gradually, changes of the contained parts may so accompany it that little if any lameness will be caused simply by the contraction. Again, the contraction may be the consequence of other disease, and the result of a partial cure and a previous lameness lessened. Contraction may result from chronic founder or fever of the feet. It may be produced by long-continued stabling upon a dry plank floor. Thrushes may so demoralize the floor of the foot as to cause contraction. Too great and constant paring away the bars of the foot may destroy their resistance to the approach of the heels, so the paring of the frog may destroy the function of that organ as an elastic spring to keep the heels open. The degree of lameness that follows the change of form produced by these causes is not so great as when it results from inflammation of the elastic portions of the foot. The changes are more rapid, and pressure is made upon the sensitive portions of the foot. The horse indicates the amount of pain he suffers by the peculiar short and quick character of his step, and the gentle and light manner in which he places his feet upon the ground. When not in motion, he rests his feet forward, and is continually changing them. Contraction is apt to be seen most frequently in highly bred horses with a naturally high and narrow foot. This is one of the causes of lameness in which the advice and probably the treatment of an edu-

cated veterinary surgeon are important. No definite directions for treatment can be given.

There are several other forms of disease in the foot, but they are either so slight, or so rare, or so little amenable to treatment, that we will not cumber this article with them. In closing, we advise that in all serious or doubtful cases of lameness an educated veterinary surgeon be called. If such a one is not obtainable, the advice of an educated physician may aid in determining the locality and cause of disease. This known, treat the case according to the suggestions of this article.

THE FOOD FISHES OF ALASKA.

Though not generally appreciated, the importance of the Alaska fisheries to the population of our western coast can hardly be overestimated. At the present time, however, the American fisheries upon the coast of Alaska are almost exclusively devoted to the capture of the cod. In the following paper we give a résumé of the growth and condition of that fishery, and also some account of the other marine and of the fresh-water fish of the Territory, the periods when they appear, the methods of capture, and the extent to which they may be made available by our American fishermen, either as bait or for home consumption. For convenience in reference, they will be divided into two classes, marine and fresh-water fishes, and the details of the fisheries will be given in general under the respective heads. To assist the fishermen and others in their intercourse with the inhabitants of the Territory, the native and Russian names of the several species are given, whenever known, as well as the English and scientific names. The range of the several kinds in these waters is also given, as far as possible, and the seasons during which they especially abound. Few observations having been made by competent men upon these points, the information here recorded is necessarily very far from complete. When we recollect that a population of thirty thousand souls has from time immemorial sustained itself chiefly on the product of the fresh-water fisheries, and that, with all the prodigality and want of forethought characteristic of aborigines, few ever suffer with hunger, we may more adequately recognize the abundance of the finny tribes.

MARINE FISHES.

The principal marine fishes of Alaska are the cod, halibut, herring, ulikon, smelt, mullet, and tom-cod.

COD.—*Gadus macrocephalus*, Tilesius; Russian, *Treska*. *Gadus*, Sp., "small cod" of the fishermen.

Cod, in the North Pacific, as in the North Atlantic, are the most important of the marine fishes from a numerical as well as an economical point of view. They form the staple of the Alaska fisheries at present. They have from time immemorial formed one of the staple articles of food upon which the littoral inhabitants of the Territory rely. Their distribution is extensive, ranging from the Straits of Fuca to the ice-line of Bering Sea, in latitude 59° north. This line appears to be their northern boundary, although it is possible that stragglers

may find their way north of it during the summer season. This ice-line is the southern line reached in mid-winter by the floating ice, and it forms the northern boundary of many southern animals, as well as the southern limit of many arctic forms, not only of fish, but of other animals, and of plants. The distribution of the cod, east and west, north of latitude 50° north, is only limited by the line of the coasts of Asia and America. The shallow waters of the Ochotsk Sea were noted for their cod fisheries before the Alaska fishing grounds were open to American enterprise, and have only been less frequented since the latter, more easy of access and provided with numerous safe harbors of refuge in stormy weather, have come under our jurisdiction.

The time of reaching the peninsula of Kamchatka, according to Mr. Davidson, who has collected many facts in regard to the North Pacific cod fishery, is about the 1st of July; but good, small fish may be taken as early as the 1st of June in the Kurile Strait. At this date, fish are not found on the west coast of the peninsula. In July fish may be taken in moderate quantities on the southeast side of Cape Lopatka, the southern extremity of Kamchatka, and in the western part of the Kurile Strait; but the best fishing grounds commence about forty miles northwest from Cape Lopatka. Here, at the beginning of the season, the fishery is near the shore, but it is twenty to twenty-five miles from land in latitude 52° 30′ north to latitude 53° north. On this ground they are usually taken in twenty-five to thirty fathoms of water, though they are found in sixteen fathoms within three miles of the land. They are also caught eighteen to twenty miles from shore, in depths from forty-five to sixty fathoms, according to latitude.

When the fish first come upon the west coast of Kamchatka, about the first of July, they are thin and poor, but improve rapidly. Fish taken here two weeks after their arrival on the ground are a little larger than those taken on the coast of Labrador, but not so large as those taken on the Grand and other off-shore banks in the North Atlantic. In quality they compare very favorably with the latter. For bait the vessels have taken salt herring from San Francisco; some have carried fresh herring, from Petropavlovsk, in snow and ice; others have used the small halibut caught on the cod banks.

In 1866 about fifteen vessels sailed for the Ochotsk. Vessels should leave San Francisco as early as March, arriving upon the grounds in April, and leaving the banks for San Francisco in September. The most fruitful of the Alaska fishing grounds are considerably to the north of the southern limit of the migrations of the cod, and may be said to extend northwest from Yakutat or Bering Bay along the coast and the line of the Kadiak and Aleutian archipelagoes. The cod-banks are generally in the vicinity of land, yet off-shore banks have been and will continue to be discovered, though the fishermen endeavor to retain the secret of such discoveries. Such banks are usually to be looked for in the direction of the trend of the adjacent islands or in lines parallel to that trend. The soundings of Portlock, Vancouver, and the United States Coast Survey expedition prove the existence of a comparatively shoal bank extending along the southeastern coast of Afognak and Kadiak, with a deep pocket (no bottom at ninety fathoms) twenty-five miles east of St. Paul. The shoalest water found upon this bank, by Mr. Davidson, of the United States Coast Survey, was forty-five fathoms. It probably extends along the southeast shore of Kadiak. Belcher caught cod and halibut under Cape Greville, the eastern point of Kadiak. South by east, fourteen miles from the eastern end of the easternmost point of the Trinity Islands, Vancouver found bottom at

fifty fathoms; and fifteen miles south of Ukamok at seventy-five fathoms. Thirty-five miles east of the south end of the island of Niuniak, the most southern of the Shumagin group, Mr. Davidson obtained bottom at forty fathoms, and nine miles southeast of the Sanak reef at thirty-five fathoms. Near this last-named locality, Cook caught over one hundred halibut, ranging from twenty to one hundred pounds each. He therefore called it Halibut Island. Mr. Davidson discovered a fine cod-bank about sixty-five miles southeast (true) from the middle of the Akutan Pass, and forty miles south-southeast from the Unimak Pass. Here the water has a depth of sixty fathoms, with pebbly bottom. Many fine cod were caught, of which one was thirty-six inches long, twenty-three inches in girth, and weighed twenty-seven pounds.

Some of the vessels are said to commence fishing along the coast north of latitude 54° 40′ north, and to work northward along numerous banks which they have found. The fish are taken in from fifteen to forty fathoms, the very best fish in the deepest water. The banks along the Gulf of Alaska, around the Kadiak group, and part of the Aleutian chain, have an area of not less than forty-five thousand square miles, with a depth of not over fifty fathoms. If the fishing depth extends to one hundred fathoms, there is little doubt that the cod-fishing area will reach one hundred thousand square miles. In addition to the fisheries of the great bank, the cod are reported to run in great numbers in and around the entrance of Hamilton Bay, near the western part of Frederick Sound. Lisiansky caught them with hook and line in Sitka Sound; Portlock, abundantly, at Port Etches; and Belcher near Cape Chiniak.

The importance of the possession of the Aleutian chain can hardly be overestimated; not only can our fishermen enter and fish in every bay when heavy weather compels them to leave the banks, but they are afforded ample opportunities for the successful curing of the fish, certainly as great as, if not greater than, exist on the southern shore of Newfoundland. Mr. Davidson suggests that, instead of making the long trip to and from San Francisco, and keeping the fish so long in salt, especially if imperfectly cleaned, it would be feasible to make a general depot and curing establishment, for instance at Kadiak, where vessels could carry the catch of all the smacks, which might easily refit in winter and be ready for the opening of the next season. Kadiak is preferable, as affording the nearest timber available for repairs, and as already being the depot for the ice-trade of the Pacific. The Aleuts are patient, skillful, and fearless in their fishing, and under proper guidance might be very profitably employed in the taking and curing of fish. The waters between Aliaska Peninsula and the Shumagin Islands are well protected from the heavy swell of the Pacific, and afford the great advantage, that vessels while fishing may always lie under the lee of some one of the numerous high islands, thus making fishing a much more comfortable business than when riding out in the open sea.

The fish abound in proportion to the quality of the bottom, and quantity and kind of the food it affords. A muddy bottom seems to supply the greatest development of the marine life upon which it subsists, and when the depth of water is greater than fifteen fathoms the flavor of the fish is not impaired thereby. At a less depth, however, the fishermen report that the fish are of an inferior quality. The spawning ground of the North Pacific cod has not yet been discovered, and a rich harvest will await the fortunate fisherman who may chance to light upon it. It is well known that at the spawning season the fish are in their finest condition, most abundant, and most easily caught. It is possible that the

southeastern coast of Kamchatka and the Kurile islands may be the locality, and it would be worth while to examine these localities at the season when the fish are absent from their usual feeding grounds among the islands.

The cod have been found in more or less abundance along every part of the northwest coast within the limits above mentioned, but at present the favorite locality appears to be in or about the Shumagin group of islands. These islands were discovered by Bering, in his second voyage, on the 29th of August, 1741, and were named after one of his crew who died and was buried upon one of them. They are situated in longitude 160° west and latitude 55° north, and comprise four large and about a dozen small islands, with a total area of about a thousand square miles. They contain several Aleutian settlements, and Unga, the largest, has two fine ports, the north and south harbors, where wood, water, bait, and fish abound. The banks already discovered exceed in extent those of Newfoundland. The best banks in the Ochotsk Sea are on the west coast of Kamchatka, and near the north end of Sakalin Island. The round voyage to the Ochotsk Sea averages one hundred and seventy days, without facilities for obtaining bait or fresh provisions, and with no good harbors. The voyage to the Shumagins and back occupies about one hundred and ten days, a saving of two months and two thousand miles in time and distance, in addition to the facilities for obtaining fresh provisions, wood, and water, and the proximity of good harbors of refuge in bad weather. The fishermen about the Shumagins usually run into North Harbor on Saturday night, and spend Sunday in resting from their labors.

The fishermen who make the voyage on a "lay" are said to clear about $100 per month during their voyage. The supply of bait has sometimes been taken from San Francisco, at a cost of about $100 for a vessel of one hundred tons. Others have relied on halibut and sculpins taken on the ground. There is hardly a locality with a muddy bottom where the dredge would not bring up, with but little labor, an abundance of shell-fish suitable for bait. This is known to be the case in North Harbor, Unga Island, and we are informed that it is also true of all the places where the dredge has been tried. Herring and other small fish in their season might be obtained with a seine in immense numbers at slight expense, and the squid, the most taking of all baits for the cod, is extremely abundant at Sitka and many other localities. There appear to be two kinds of cod on the North Pacific fishing grounds, which may or may not be stages of growth of one species, but they are certainly different from the Atlantic codfish. The first of the two kinds referred to is small, but of good quality, and is supposed to frequent the banks during the entire year. The larger species arrives on the banks about May 10, and disappears about the 10th of September. These average 7.2 pounds when salted, and are a little smaller than the fish obtained in the Ochotsk Sea; but they dry heavier, averaging about four pounds. Both kinds differ from the Atlantic cod in having larger heads in proportion to the size of their bodies.

Cod have been taken in abundance at Nootka, Sitka, Lituya Bay, Yakutat Bay, Chugach Gulf, Cook's Inlet, Bristol Bay, and throughout the Kadiak, Aleutian, and Pribyloff Islands. In 1865 and 1866 the Western Union Telegraph exploring vessels obtained an abundance of fine cod in North Harbor, Unga Island, and off Unimak Island, in forty-five fathoms, in the months of August and September.

The weather on the fishing banks from June to the middle of August is rainy and foggy, with light southeast winds. From that time until

the latter part of September northwest winds and fine weather are the rule. Later in the season heavy southerly gales occur. Notwithstanding the weather, which much resembles that of the Newfoundland banks, there is no serious obstacle to drying and salting the fish ashore, as on the Labrador coasts. The folly of statements to the contrary is evident, when we recollect that the principal dependence of the large native population in winter consists of fish dried without salt during the summer season. It may be safely estimated that not less than five hundred thousand fish are annually dried in this way for winter use; indeed, Russian statistics show that, in a single season, at one station alone, over four hundred thousand were thus prepared. The Aleuts and other tribes fish for cod with a large hook made of wood and barbed with bone, lashed on with seal-skin thongs, and with a line of the twisted fibers of the *Macrocystis*, or giant kelp, which often grows to the length of one hundred and fifty feet.

The supply from the Alaska banks has stopped the importation of codfish from the eastern ports into San Francisco, and much larger exports may be expected, when the curing process is properly understood and carried out. The yearly supply from the Atlantic States was formerly about five hundred tons. The fish were not cured upon the Aleutian Islands, because the territory belonged to Russia, but were kept in salt about six months, or until the return of the vessel to San Francisco, evidently to the injury of the cargo. Many of the persons engaged in the fishery knew nothing of the proper method of curing and preparing the fish, yet the prices commanded were from 7½ to 13 cents per pound in gold; in February, 1868, the average rate was 9 cents per pound. One vessel carried a full cargo direct to Australia, and received 8 cents per pound. The price in 1870 averaged 7 to 8½ cents per pound in gold. New cargoes of fish have been disposed of as high as 13 cents per pound. In the quarter ending June 30, 1868, five hundred and twenty-one hundred-weight of fish were exported from San Francisco to New York. These exports are constantly on the increase, and San Francisco, at this moment, supplies the Sandwich Islands, Australia, and the entire west coast of North and South America, with the product of her fisheries. Many Cape Ann and Gloucester fishing schooners have gone around Cape Horn, and are now plying their vocation in the North Pacific. The total amount of fish imported from foreign waters into the United States during the eight months ending August 31, 1867, was nine hundred and ninety-four thousand nine hundred and eighty-eight pounds; for the same period of 1868 it was nine hundred and twenty-seven thousand five hundred and forty pounds; and the value of cod imported during the quarter ending June 30, 1868, was $119,127. These facts show abundant room for the extension of the fisheries in American waters. It is to be regretted that since the purchase of the Territory of Alaska no exact record of the imports of fish has been kept, as they come under the head of coastwise trade. The immense catch of 1867 temporarily overstocked the market, which will account for the fewer vessels employed in 1868; yet this fact stimulated foreign merchants, and the result has been a large and rapidly increasing export trade.

No tongues and sounds and but little cod-liver oil have been saved. In 1866 ten thousand gallons of cod-liver oil were reported. There is no doubt that this amount will, in future, be largely increased. The following is the extent and value of the Pacific cod-fishery since its origin, estimated from all the available sources of information, and with the valuation computed from the average of the rates for the season:

Year.	No. of vessels.	Pounds of salted fish.	Value of the fish in gold.
1864	1	288,000	$31,680
1865	....	1,255,200	125,520
1866	18	2,873,600	332,624
1867	23	5,121,600	348,110
1868	19	3,417,600	273,408
1869	27	7,390,400	591,232
1870	33	10,612,000	754,840
Total	....	30,958,400	2,457,414

TOM-COD. *Gadus gracilis*, Tilesius; Russian, *Waúkhni;* Innuit of Norton Sound, *Ikothlŭk.*

This fish much resembles the common tom-cod of the Eastern States, (*Gadus polymorphus*, Mitch.,) but, while the latter is of most insignificant importance from its scarcity and poor quality, the former species occupies a very important place in the domestic economy of both natives and Russians, on both shores of Bering Sea. It is apparently a permanent inhabitant of these coasts, but is most abundant in the fall of the year, when the ice begins to form in the rivers and along the shores. The Waúkhni fishery commences about the middle of October. At first it is caught from boats anchored close in-shore, but later the natives cut holes in the new ice, set up two or three stakes, with a mat hung upon them to keep off the wind, and sit there all day, hauling them in as fast as the line is dropped into the water. The hook is made of white walrus ivory, furnished with a sharp pin set in obliquely, but without a barb. The whiteness of the ivory, which is kept constantly in motion, attracts the fish, but no bait whatever is used. In November, when the ice becomes very thick, and the cold increases, the fish retire to deeper water, and the fishing is over until the following spring. In the summer the natives are occupied with the salmon fishery and pay no attention to these small fish. They are preserved by removing the intestines, and drying in large bunches strung on seal-line, or by throwing them as they are into long cylindrical baskets made of twisted grass, and keeping them entire in a frozen state. On the Kamchatka coast they are caught in seines, and preserved frozen in great heaps upon staging erected for the purpose. They are among the most palatable of the many fish found in these seas, and the number preserved is so great as to be almost incalculable. They serve the natives for food, either boiled or in the frozen state. They also form an important article of dog-feed in the northern portions of Alaska, near the coast. They are well suited, from their abundance and firm flesh, to be used as bait in the cod-fishery.

HERRING. *Clupea mirabilis, Girard;* also, *Clupea sagax*, Jen.; and probably other species of *Clupea;* Russian, *Koraski*, *Selotka;* Innuit of the Kuskoquim River, *K'pookachat.*

The herring of Bering Sea, and the North Pacific generally, resemble those of the North Atlantic, but belong to different species. They arrive in Norton Sound about the 15th of June, in countless myriads. They visit Sitka earlier in the season, but we have not been able to discover the exact date of their appearance. They are equally abundant

in June on the coasts of Kamchatka, and, indeed, throughout Bering Sea, as far north as Bering Strait. On Norton Sound the fishery lasts but a fortnight. The fish are secured in seines, and kept until they are half putrid, when they are reckoned a great delicacy. The same custom obtains in Kamchatka. Near Sitka, and through the adjacent archipelago, they come in vast schools, and the Indians of the Thlinket nation go out in their cedar canoes, furnished with a lath, through which three nails are driven, and the projecting points well sharpened. Beating the water with this implement they throw the fish by a dexterous motion into the canoe, which can be filled easily in half an hour. So great is the abundance of the fish that it is "rare not to see a herring on every nail."

In September, when drawing the seine for salmon at Iliuliuk Harbor, Unalashka, the Coast Survey expedition obtained herring of large size, fatter and of much finer flavor than the herring caught on the California coast. Portlock mentions that when hauling the seine, June 11, in Port Etches, hogsheads of small but very good herring were obtained, and salted for the use of the crew. Lisiansky says that herring swarm in Sitka Sound every spring; and Seemann states that herring and whiting are caught in great quantities in Hotham Inlet, Kotzebue Sound, in latitude 67° north. These fish, besides their intrinsic value, have an important bearing on the question of the cod fisheries, in supplying bait, which is now brought from San Francisco for that purpose at high prices. Up to the present date no attempt appears to have been made by Americans to utilize this herring fishery.

ULIKON. *Thaleichthys Pacificus*, Girard; *Ulikon* of the natives and English.

The ulikon has long been an icthyological curiosity, and has been noticed by almost every traveler who has visited the coasts of British Columbia and Southern Alaska. It is a small, silvery fish, averaging about fourteen inches long, and, in general appearance, much resembling a smelt, (*Osmerus*.) They are the fattest of all known fish, and afford a very superior oil when tried out. Dried, they serve as torches; when a light is needed, the tail is touched to the fire and they will burn with a bright light for some time. No description can give an adequate idea of their numbers when ascending the rivers from the sea. The water is literally alive with them and appears to be boiling. Wild animals draw from the stream with their paws sufficient for all their needs.

These fisheries, as far as we are aware, have not been utilized except by the natives. The most important of the native fisheries is on the Nasse River, near the southern boundary of Alaska. The spot is named *Kit-lak-a-laks*, and a Catholic mission was and still may be situated there. Many tribes come to these fisheries, which begin about the 20th or the 25th of March. The first fish is addressed as a chief; apologies are made to him by the Indians for the necessity of destroying his kindred for the supply of their own wants; a feast is given with appropriate songs, speeches, and dances in his honor; and after that the fishing goes on. The fish are caught in wicker baskets, and are dried or smoked as much as their oily nature will allow. The fishing lasts a fortnight or three weeks, and supplies many hundred aborigines with food for a considerable period.

HALIBUT. *Hippoglossus vulgaris?* Cuv.; *Kámbala and Pálloose* of the Russians.

These fish are frequently smaller than those of the Atlantic fisheries,

but near Sitka and along the coast they are often taken from three hundred to five hundred pounds in weight. Their range is from the Aleutian Islands southward to Cape Flattery. They are not found north of the ice-line in Bering Sea, except, perhaps, in summer. They extend westward into the Ochotsk Sea with the cod, and already form an article of commerce among the west-coast fishermen. They are said to surpass the eastern halibut in flavor when properly cured. The weight of the annual catch has not been recorded.

SMELT. *Hypomesus olidus*, Gunther; *Karúshka* of the Russians.

This excellent table fish ranges from San Diego, California, northward along the entire coast. It does not occur in sufficient numbers to render it an article of commerce, except near large settlements. It is very abundant, however, at Sitka, and in other localities.

Other marine fishes exist on the coast of Alaska, which form articles of food to a greater or less extent. The mullet (a species with which we are not familiar) is said by Seemann to replace the salmon on the sea-coast north of Kotzebue Sound. Among other species noticed, but not yet determined, the following are known to occur on the Alaska coast: *Pleuronectes quadrituberculatus*, Pallas; flounder. *Platessa stellatus*, Girard; spiny flounder. *Hexagramma stellerii*, Tilesius; sculpin. *Hemilepidotus trachurus*, Pallas; sculpin. *Mallotus villosus*, Müller; capelin. *Orthagoriscus analis*, Ayers; sunfish. *Eumicrotremus orbis*, Gunth.; globe-fish. *Hippocampus ingens*, Girard, and another species of *Hippocampus*, the sacred fish of the Makah tribe of Indians at Cape Flattery, who have many superstitions connected with it.

FRESH-WATER FISHES.

The fresh-water fishes, in point of numbers and the quantity of food which they furnish, are even more important than the exclusively marine fishes. These chiefly comprise salmon, white-fish, losh or burbot, (sometimes called eelpout,) pike, and suckers. We have thought it best to give the names and descriptions of these different fish, and append an account of the method of fishing for them, which is much the same for all the species.

KING SALMON. *Onchorhynchus orientalis*, (Pallas,) Gunth.; Russian, *Chowichee;* Tinneh tribes of the Yukon, *Khak;* Innuit of the Kuskoquim, *Tagyakrák;* Indians of Cook's Inlet, *Telági;* Thlinkets or Koloshians of Sitka, *Ashat;* Innuit of Norton Sound, *Takiyukpuk.*

This is the largest and finest of the Alaska salmon, reaching a weight of sixty to ninety pounds. Those weighing eighty pounds are not uncommon, and others weighing a hundred-weight have occasionally been taken. This fish, or a fish called by the same name, ranges from Sitka to Bering Strait, and is found in all water-courses from the tideways of the Alexander Archipelago to the broad current of the Yukon. It ascends the latter river for at least twelve hundred miles, and perhaps farther. It is a short and broad fish, with a large head, but comparatively small mouth and fins. It reaches the mouth of the Yukon about the middle of June, and runs for six weeks. It ascends the river slowly, reaching Fort Derabin (about three hundred and sixty miles above the mouth of the river) about the first week in July, and Fort Yukon (about one thousand miles above the mouth) about the middle of July. It is dried for winter use by the natives. All dry fish is called *ukali* (or *yoókalee*) by the Russians. The chowichee ukali are

made by cutting the fish in three slices, after removing the head, leaving the back-bone in the middle slice, and all three connected by the tail. Two or three dry chowichee ukali will weigh at least fifty pounds. One of them is accounted sufficient for a day's food for six men or dogs. They cost, from the natives upon the Yukon, one leaf of tobacco each, or, when dry, five to eight musket-balls per ukali. The more northern the ground where the fish are taken, the finer their flavor, and the chowichee of the Yukon were held in such esteem that several hogsheads were annually salted for the Emperor's table by the Russians.

SALMON. *Onchorhynchus lagocephalus*, (Pallas,) Gunth.; Russian, *Kéezich;* Tinneh tribes of the Yukon, *Nŭ'giaghúh;* Innuit of the Kuskoquim River, *Kakia.*

SALMON. *Onchorhynchus proteus*, (Pallas,) Gunther; Russian, *Hoikoh;* Yukon Tinneh, *Nŭg'laghúh;* Innuit of the Kuskoquim, *Nikniat.*

These two species have the same range as the king salmon, and are dried for food in the same way. They are, however, much more common, much smaller, and are held in less esteem. They form the bulk of the better class of salmon in all the rivers of Alaska. They arrive later than the king salmon, remain longer, and travel more rapidly. They reach Fort Derabin upon the Yukon about the 10th of July, and Fort Yukon early in August. They weigh from ten to thirty pounds, and dry, after cleaning and removing the back-bone, to about two or three pounds. They are more slender than the king salmon, and the males are furnished in the breeding season with a formidable array of recurved teeth, so that the natives are accustomed to knock them on the head with a club before attempting to remove them from the nets.

RED-FISH. *Onchorhynchus sanguinolentus*, (Pallas,) Gunther; Russian, *Krasnoi riba;* Yukon Tinneh tribes, *Neliyúh;* Innuit of the Kuskoquim River, *Nikeet.*

BLACK SALMON. *Salmo purpuratus*, Pallas.

DOG-FISH. *Onchorhynchus lycaödon*, (Pallas,) Gunther; Yukon Tinneh, *Nŭlaghúh:* Russian, *Korbushka;* Innuit of the Kuskoquim River, *Amakak.*

These species are principally valued for use as dog-feed. They are placed in the order of their quality as articles of food. The *purpuratus* is not found north of Aliaska Peninsula. They are all exceedingly common, of small size, and appear later than the previously mentioned varieties. The red-fish, as its name denotes, is partly of the most brilliant scarlet, but its flesh is not so red as that of the king salmon or the *hoikoh.* They arrive in July, and disappear late in August.

SALMON TROUT. *Salmo alpinus?* Linn.; Russian, *Kolshéh;* Yukon Tinneh tribes, *Kholotusúh:* Ulukuk Tinneh, *Kokolimyá:* Innuit of the Kuskoquim River, *Ankliogat.*

This fish appears much more abundant in the smaller rivers than in the larger ones, such as the Kuskoquim and Yukon. They are seldom or never found in the lakes, as far as we have been able to ascertain. They remain in the rivers during the entire year, and are caught in the greatest abundance during the winter months. The Ulukuk River, in Northern Alaska, is especially noted for these fish, which are most delicious, far exceeding any other fish of the country in their delicate and delightful flavor. They seldom weigh over ten pounds, and average two pounds in weight. They are very beautiful in appearance, silvery,

purple, and olive, with scarlet spots, and are very slender, almost subcylindrical in shape.

BROOK TROUT. *Salmo* sp.

Brook trout are not found north of the peninsula of Aliaska, on the American side of Bering Sea. They are obtainable at Avacha Bay, on the Asiatic side, but probably do not go much farther north. They have been observed at North Harbor, Unga Island, in the streams of Cook's Inlet, and near Sitka. They are usually very dark colored, indeed almost black.

THE SALMON FISHERY.

Next to the cod and herring, the salmon fishery is undoubtedly the most important branch of this traffic. The number of this fish on the Alaska shores is inconceivable. "Chatham Harbor," writes Portlock, "is filled with salmon; the small river which empties into it is swarming with them; the bears come down and feed upon them, catching the fish with their paws, and eating only the head. I have sometimes seen twenty bears thus engaged in one day." On the same authority, the anchorage at Port Etches afforded two thousand salmon at one haul of the seine; they existed in such numbers that any quantity might have been obtained. Vancouver reports "salmon in great quantity leaping in all directions" in the Portland Canal, July 29, 1793. Salmon and trout were found in great abundance in the rivers falling into Lituya Bay by La Perouse. The Stikine River, according to Mr. Davidson, of the United States Coast Survey, abounds in salmon, which are split and the back-bone taken out, and are then cut into strips and smoked by the natives. Thirteen hundred natives, living between Chugach Gulf and Yakutat Bay, live exclusively upon fish, which they obtain with the greatest ease, according to Tebenkoff. Mr. Davidson says:

At some of the entrances to shallow fresh-water streams the water is packed with salmon. On some of the beaches near these streams the seine will take them in thousands. In the bays leading to the small streams at their head, on the southeast side of Aliaska Peninsula, the salmon are crowded so thickly that the progress of a boat is impeded, and should a southeast storm arise at such times, the fish are driven upon the beach in innumerable quantities. One of the Russian navigators assures us that he has seen the beach strewn two or three feet thick with the stranded salmon.

The chief winter food of the natives is salmon, dry and smoked, of which they provide very large quantities. Seemann says:

Salmon, so numerous in Norton Sound, latitude 64° north, are not found to the northward of Buckland River, emptying into Kotzebue Sound, in latitude 66° 05′ north. They appear, however, to be replaced by the mullet, which attains a considerable size. I obtained for a blue bead a mullet thirty-three inches long, weighing twenty-one pounds.

The number of salmon annually consumed by the natives of Alaska cannot be less than twelve millions, at the lowest estimate. At the Russian fishery near Deep Lake, Baranoff Island, eighty-four thousand one hundred and fifty-nine fish were obtained during a single season, of which two-thirds were salted. At the fisheries upon Kadiak and Cook's Inlet, four hundred and sixty-five thousand salmon were caught annually. Among the articles sent by Baránoff to the Sandwich Islands were four thousand three hundred and forty-four casks of salted salmon, which realized the sum of $69,871 in coin. At the mouth of the Yukon not less than two million salmon are annually dried for winter use, and probably double that number. Words fail to give an adequate idea of their number. We have seen the weak and injured fish which

die after spawning stranded in piles, three or four deep, on the banks of the Unalaklik River, a small stream flowing into Norton Sound.

The following notes in regard to the running of the Yukon salmon were obtained from the natives at Fort Derabin, Nulato. *King salmon:* arrive at Nulato "when the trees have got into full leaf," about the 20th of June, and continue to run about three weeks. The last that come up are poor and lean. *Hoikoh:* the first arrive about the 10th of July, just as the king salmon are about gone, and they last about three weeks. Stragglers are occasionally caught as late as January. *Red fish:* this arrives about a week or ten days after the first hoikoh, and continues with the latter until about the end of August. A few straggling dog-fish are occasionally caught with it, but the majority of this species do not ascend the river as high as Nulato. *Keezich:* this is the last of the salmon to ascend the river, and is obtained until the cold weather sets in and puts a stop to the summer fishing.

In Kazarn Bay, Clarence Sound, a Russian, in July, 1868, put up two hundred barrels of salmon a week, and, had he been provided with sufficient facilities, might have packed double that number. The salmon run there from July 1 to August 30.

The United States Coast Survey has made a sketch of the outlet of Glubokoi, or Deep Lake, near Sitka, on the south side of Sitka Sound, where the Russian American Company have built traps, dams, foot-bridges, and houses in the most substantial manner. The dams and traps lie across the upper part of the rapids, which have a fall of nine feet over rocks. The traps are large rectangular spaces, made with stakes placed near enough to each other perpendicularly to allow a free flow of water, and yet to prevent the salmon passing between them. The side of the trap toward the descent has an opening like the entrance to an ordinary rat-trap on a large scale. The fish rush up the rapid and pass through the opening to the staked inclosure, where they remain swimming against the moderately strong current. When several salmon have entered, they are lifted out with a kind of wicker basket and placed in large boxes lying between the traps, of which there are six, with means of adding as many more. The last year's catch that was packed for market amounted to five hundred and twenty barrels, containing eighteen to twenty-five salmon each, and weighing, when packed, about two hundred and fifty pounds. As high as one thousand salmon have been taken in one day. In 1868, the year's catch, under the impetus of American enterprise, was two thousand barrels.

There are, however, many localities at which salmon are much more plentiful than at Sitka. Mr. Davidson states that at the Russian trading post and salmon-fishery at Karta Bay, in 1868, it was expected that three thousand barrels of salmon would be put up. Mr. J. Pfluger, Hawaiian consul at Petropaulovsk, on the west coast of Bering Sea, informed us that, with the aid of two men and a few native women, he was enabled to put up six hundred barrels of salmon in the course of the season of 1866. The fish were caught with a seine, in a small cove of Avacha Bay, and, being sent to the Sandwich Islands, were sold at a great profit, the gain from this operation alone amounting to much more than the profit upon the trade in Siberian sables, in which he was engaged for the previous three years. Large fisheries have been for some years located upon the Columbia River. The fish are taken only in gill-nets, at night, when the water is clear. Two men, with their boat and net, will average twelve hundred pounds in one night. The river being a mile and a half wide at the locality of the fishing grounds, most of the salmon escape, and the product of a night's work seems paltry and insignificant, com-

pared with the catch which may readily be obtained by the Russian method practiced in Alaska. The northern salmon fisheries, after the traps and dams are once laid, can be prosecuted with a tithe of the labor employed on the Columbia River. The northern salmon are also superior in size and flavor.

Five establishments on the Columbia have put up salmon for several years in hermetically-sealed cans. This canned salmon will keep for many years in any climate without deterioration. Hence it brings a very high price. In 1870 these establishments canned about one million eight hundred thousand pounds. This was sold at prices averaging 14 cents per pound, a total value of $252,000; beside which, other parties salted salmon to the amount of five thousand barrels, which, selling at 5 cents per pound, afforded the sum of $62,500.

It is certain that salmon can be packed in almost any part of Alaska and landed at San Francisco at a cost of not more than $5 a barrel, including freight and all other expenses. There they will readily command $12 a barrel. Should parties desire to can the salmon, though requiring at first a larger investment of capital, the prices and profits realized might be much greater.

The white-fish of Alaska have not yet entered into commerce; those of Lake Superior command very high prices, and it is reasonable to suppose that when the fisheries of Alaska are worked in earnest by American enterprise, so fruitful a source of profit will no longer be neglected. The species are as follows:

GREAT WHITE-FISH. *Luciotrutta leucicthys*, (Pallas,) Gunth.; Russian, *Naylima*; Tinneh tribes of the Yukon, *Nt'lagha*.

This enormous white-fish is the finest of its tribe, both in size and flavor. It is found in the rivers most of the year, but is most plentifully obtained and is in its best condition about the months of June and July. We have seen them four feet long, and weighing about fifty pounds. It is distinguished by its long nose and slender form, and is of a silvery white, somewhat darker above. It is full of spawn from September to January, when it disappears.

BROAD WHITE-FISH. *Coregonus muksun*, (Pallas,) Gunth.; Russian, *Mŭksŭn*; Tinneh tribes of the Yukon, *Teliyuh*; Innuit of the Kuskoquim, *Ka-ukhtoot*.

This is the next in size of the Alaska white-fish, and reaches a weight of thirty pounds. It is distinguished by its broad body, short head, and large scales. It is usually very fat, and excellent eating. It abounds in both winter and summer, spawning in September in the small rivers falling into the Yukon.

ROUND-FISH. *Coregonus nasus*, (Pallas,) Gunth.; Tinneh tribes of the Yukon, *Hŭk'ten*; Russian, *Krug*.

A long, slender, subcylindrical fish, not very abundant, but of excellent quality. They are caught occasionally throughout the winter on the Yukon, and are distinguished by their attenuated muzzle and peculiar form.

HUMPBACK. *Coregonus*, sp. indet.; Russian, *Korabati*; Tinneh tribes of the Yukon, *Kolokŭh*.

A common species, characterized by the strongly arched back and broad tail. The scales are large, and the fish rather bony, and inferior in flavor. It is generally used for dog-feed, except in times of scarcity.

WHITE-FISH. *Coregonus*, sp. indet.; Russian, *Morskoi ciga;* Tinneh tribes of the Yukon, *Telmŭkkah.*

This is the most abundant and best-flavored species of *Coregonus* in most localities. It is distinguished by its small scales, fins, tail, and head, and is of symmetrical proportions and moderate size. It rarely exceeds three pounds in weight, and is the staple article of food in winter on the Yukon.

NULATO WHITE-FISH. *Coregonus*, sp. indet.; Russian, *Nulatoski ciga;* Tinneh tribes of the Yukon, *Seeghuh.*

This is a small, thin, bony species, common near Nulato, on the Yukon, and is rarely more than half a pound in weight. It is of little use as food, and is principally abundant in summer.

GRAYLING. *Thymalis Pallasii*, Cuvier; Russian, *Koruski;* Tinneh tribes of the Yukon, *Telmyah;* Hudson Bay traders, *blackfish* or *blanket fish.*

Abundant in the small rapid rivers of Alaska. It is the only fish in the Yukon Territory which will take the hook. It is of moderate value only, for table use, and is especially abundant in spring, when the white-fish begin to be scarce. It is a most beautiful species; a specimen obtained at Nulato, April 7, 1866, gave the following notes: "Dorsal fin extremely long, gray, with clear spots, each centered with scarlet. The extreme tip of the fin, dark blue. Tail broad, dark, flecked with streaks of crimson. Abdominal fins each with four narrow streaks of light pink. The pectoral fins with several scarlet blotches. Eyes silvery, grass-green on the upper part of the orbit. A large black blotch on each side below the lips, and twelve or fifteen small ones well forward on each side. Belly with bright coppery reflections, all the side scales reflecting pink, and dark yellow or coppery."

PIKE. *Esox estor*, Leseur; Russian, *Sukkuh;* Tinneh tribes of the Yukon, *Khēkiyŭh;* Innuit of the Kuskoquim River, *Chukak.*

Common in all the lakes and ponds of the Hudson Bay Territory and Northern Alaska, but absent from the rivers. It is caught with seines in summer and early winter. It is principally used for dog-feed, being of little value for the table. It is noticeable as being one of the East American species which north of the Alaska Mountains nearly reach the tide-water of the western slope of the continent. It spawns in April and May on the Yukon.

LOSH. *Lota maculata*, Linné; Russian, *Nalime;* Tinneh tribes of the Yukon, *Lūgūsh;* Innuit of the Kuskoquim, *Managnat.*

This fish (known on Lake Erie as the eelpout, and elsewhere as the burbot) is exceedingly abundant in the rivers and lakes of the Hudson Bay Territory and of Alaska. They grow to a very large size, and form an acceptable dish in the absence of white-fish. They sometimes reach a length of five feet, and a weight of sixty pounds. The flesh is comparatively hard and dry, and they are chiefly valued for their livers and roe. The liver is of a triangular shape, weighing a pound or two, and is an extremely rich and delicate morsel when broiled. It affords a pint or so of sweet rich oil, used by the Russians in cooking, and which doubtless might be used instead of cod-liver oil. The skin is stretched and dried, and serves the natives for trimming their deer-skin clothing, and also for windows in some localities. It resembles a dark, translucent, marbled paper.

These fish are most abundant in the early autumn, and even as late as December. They feed upon white-fish, lampreys, &c., which are found abundantly in their stomachs. They are so slow in their motions that it seems incomprehensible how the nimble white-fish can allow themselves to be caught. They are full of spawn from November till January. The roe and milt are carried in two large sacs opening into the cloaca a short distance from the fundament. They lie beneath the intestines when the fish is in its natural position, are four to seven inches long, and when full are about four inches in circumference. The ova are very minute, and of a creamy yellow color. A single losh contains millions of them. The milt-sacs are smaller, and the milt is white. The males are usually much smaller than the females, averaging eighteen or twenty inches in length, while the female reaches four or five feet. The male has a smaller liver, and one pyriform gall-bladder on the left side; some specimens, however, present the physiological peculiarity of having two or even three distinct gall-bladders opening into the same duct, and uniform in size and shape. We have never seen a double gall-bladder in a female. The roe of the white-fish is contained in two cylindrical canals running from the gills to the vent above the intestines, close to the back-bone. They are never more than an inch in circumference; the eggs are larger than those of the losh, and of a very deep yellow color.

SUCKER. *Catostomus teres*, Mitchill; Russian, *Kraskee;* Tinneh tribes of the Yukon, *Sŭnoyŭh.*

This fish is abundant in the Yukon and other large rivers in Northern Alaska. It is of moderately large size, reaching five pounds in weight. It is generally of a reddish color. The body is so full of bones that it is unfit for food, but the heads, when boiled with the roe, make a very palatable soup. These fish are filled with spawn in April, a period when other fish appear to be out of season. The eggs are of moderate size, of a yellow color, and are contained in triangular sacs, one on each side of the visceral cavity.

BLACK-FISH. *Cottus?* sp.; Russian, *Tchorny riba:* Tinneh tribes of the Yukon, *Undŭk;* Kutchin tribes of the Upper Yukon, *H'ieeweh.*

A small cottoid fish, about three or four inches long, is caught in baskets made of grass, in the spring-time in the Yukon Territory. It is found in the greatest profusion in the shallow ponds in the Kaiyuh marshes, and is principally used as feed for dogs, though occasionally eaten by the natives. It has a muddy, sweetish taste, and is of value only on account of the enormous numbers in which it is taken. Holes are cut in the ice in April and May, when these little fish swarm about them, and are dipped out with net-like baskets.

A small cyprinoid fish, measuring three or four inches in length, is caught in some of the small rivers in summer with pin-hooks, and is eaten raw by the natives, who regard it as a delicacy, under the name of *ūlūweetly.*

This completes the list of the economical fresh-water fishes of Alaska, as far as known at present. The fishery is carried on in summer in some localities with gill-nets, and in others with seines, which are manufactured by the Tinneh tribes out of the inner bark of the willow and alder, and by the Innuit out of fine seal-skin line. In the Hudson Bay Territory pounds are established by the traders, and also by the Kutchin Indians, in which a considerable number of fish are taken. In winter the

Hudson Bay men have a method of passing the seine under the ice, and obtaining a number of fish.

In strong contrast to the above awkward and clumsy method, is that practiced by the Tinneh tribes of the Yukon, the Innuit of the Lower Yukon, and the other tribes near the sea-coast to the south and east. This method has been copied by the Russians, and seems to be worthy of more extended use. I refer to the Yukon fish-traps, the *morda* of the Russians, and *Talpiakniat* of the Innuit of the Kuskoquim River. While the ingenuity of the white man can greatly simplify the native method in making the traps, the principle would seem to be hard to improve upon. We give a concise account of the manufacture and use of these traps, describing the winter traps, which differ but little from those used in summer. In the fall, or during the summer, spruce trees about six inches in diameter are obtained and laid aside for use. These logs must be green and full of sap, straight-grained, without twist or knots of any kind. When the cold weather sets in, these logs are taken into a warm room or Indian hut, and when the sap, which renders them tough and pliable, is thoroughly liquefied, they are barked, and split by wedges into pieces about an inch thick and three or four inches wide. The workman then sits on the ground, and taking a knife, makes an incision, into which he inserts a wedge, and carefully splits these pieces, partly by hand and partly by the wedge, into pieces an inch wide and thick, and the length of the log. These pieces are then picked over, all in any way imperfect are rejected, and the best are selected to make the materials for the *basket*, or receptacle of the trap. The rods are split at one end, and taking one-half in his teeth the workman gradually and carefully strips it off, until the whole are reduced to tough, pliable wooden rods a quarter of an inch each way, and about sixteen feet long. These rods are then carefully trimmed with a sharp knife, all the corners and splinters being removed, until the result, a smooth, cylindrical wooden thread, sixteen feet long, and about a quarter of an inch in diameter, is attained. The refuse rods, and all which are in any way knotted or imperfect, are reserved for the *mats*. These are quadrangular nets of wooden rods, some of which are an inch in diameter, to stiffen and strengthen the mat. They are perfectly flat, and about eight feet by ten or twelve feet. The rods are tied to each other at right angles by stout green-willow withes, a full supply of which can be obtained on any beach.

The basket is made as follows: The Indian women go out among the willow brush, and, selecting straight shoots without knots, strip off the bark, outer and inner coming off together. This is taken into the house, and the coarse outer bark stripped off, leaving the tough, white inner bark in broad strips six feet or more in length. This is split into strips an eighth of an inch wide, which are twisted into a kind of twine, similar to that employed for nets. A stout, flat, wooden hoop is made, to the circumference of which the wooden rods before mentioned are tied, at right angles; other rods are then curved in a spiral form, and the longitudinal rods firmly lashed to them. About twelve feet from the hoop the basket is tapered off to a point. The hoop at the mouth is about two feet in diameter; the opening at the other end is about eight inches in diameter, and here a small flat cover, or door, is attached in such a way that it can be readily opened or closed. The next thing is to make the *funnel*. This is done by lashing four stout sticks so as to form a square eight feet high by six wide, to all sides of which rods similar to those of which the basket is made are lashed, and a spiral series is passed around these to which they are again lashed, so that the opening at the

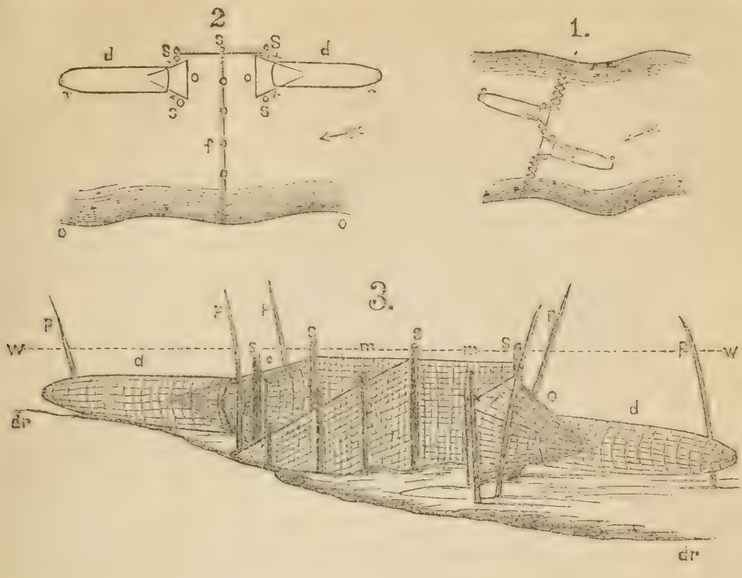
small end of the funnel is not more than six inches in diameter, and somewhat resembles the opening to a rat-trap on a large scale. The small end of the funnel is put into the large end of the basket, and the two are firmly lashed together. For this lashing, stout hempen twine is used by the Russians in preference to the trouble of getting willow twine made by the Indians.

The next step is to lay the different portions of the trap in their proper positions. When the ice is strong enough to bear the weight of a large party, a suitable place is chosen to lay the trap. This is usually a place where the shore slopes very rapidly, and the water is deep and flows swiftly. Stout stakes of some sweet wood, such as birch, willow, or poplar, are cut of such a length as to project some feet above the ice while firmly implanted in the bottom of the river below. The Indians say that stakes of resinous wood drive away the fish. These stakes are then driven into the bottom in a line at right angles to the current, the ice being cut through with four-sided iron chisels fastened on to heavy wooden poles, and very sharply pointed and edged. The stakes being driven, the mats are lashed to them on the side from which the current comes. The mats overlap each other a little, and at each junction a stake is driven, to which they are lashed. They are pushed clear down to the bottom, so that when finished the mats and stakes form an impervious fence, with interstices so small that, though the water flows freely through, no fish can pass. For the sake of convenience, the mats are usually lashed to the stakes before the latter are driven down, a procedure which requires some little care, to avoid breakage. This fence is carried out into water at least eight feet deep; it is supported by the mud into which it is driven at the bottom, and by the ice, which soon freezes firmly at the top.

At the end of the fence a cross-piece, or short fence, composed of two mats, is placed so that the whole resembles the letter T in shape. The whole is strongly supported by stakes. The baskets and funnels are now brought. The cover at the small end of the basket is made tight by lashing with a piece of twine. One long, stout, pointed pole is lashed, about three feet from the pointed end, to the small end of the basket, and two others to the sides of the funnel. A rectangle of ice, three feet wide and about sixteen feet long, is then cut out on each side of the fence, and the two baskets are put down so that one has the small end of the funnel pointing up stream and the other has it pointing down stream, while the outer side of each funnel is pressed close to the stake which forms the ear of the cross-piece of the T on the respective sides of the fence. The slender network of the basket offers little resistance to the water, as the meshes are an inch wide and two or three long, but it is maintained in its position by the pointed poles before mentioned, which are pushed deeply into the mud, and by another stake on the inner side of the funnel. The accompanying figures will illustrate: 1. Small stream closed with fascines and two basket traps. The arrow indicates the course of the current. 2. Diagram of an ordinary trap on the bank of a wide river——*o*, mouth of funnel; *b*, basket; *f*, fence; *oo*, river bank; *x*, poles attached to funnel and basket. 3. Side view of same——*rb*, river bank; *s*, stakes; *w*, *w*, water line; *m*, mats of fence; *o*, funnels; *b*, baskets; *p*, *p*, poles attached to baskets by which they are held in position against the current.

It is evident that any fish coming up or down stream in the shallow and more quiet water near the river bank (as they invariably do, always avoiding the current) will meet an obstacle to its progress in the fence. It will follow this in search of an opening until it arrives at the cross-

piece of the T, and still continuing it reaches the funnel, in which it sees a small opening, and, in the vain hope of escape, passes through it



and finds itself in the basket, from which it cannot get out. The slender wooden rods, extremely brittle when dry, are exceedingly tough when wet: the strongest fish cannot break them. The basket being open to the water, they remain alive as long as the basket remains untouched, unless the larger ones indulge in a cannibal feast upon their smaller relatives.

The fish-traps are visited every other day by the Russians. The space of ice above the basket, being cut three or four times a week, never becomes more than a few inches thick, and is easily broken up by the heavy ice-chisels used, while that which remains untouched often becomes six feet thick. When the trap is visited, the ice is broken and the fragments taken out with a wooden shovel or scoop, with a bottom of network. The basket is not raised until all the water above it is free from fragments of ice which might cut it. The poles are then pulled up and the basket raised above the level of the ice, the cover at the small end untied, and the fish emptied out; when it is replaced as before. The water below the ice of course falls as the springs which supply the river become frozen. This necessitates an extension of the fence until deep water is again reached, and the baskets are moved out. Or, if they should be left in their place, others are put at the extremity of the new fence. This process, except when the original trap is placed directly in the channel, has to be repeated several times during the winter.

The water is lowest in January and February, and begins to rise again in March. By the end of April it frequently overflows the top of the fence, thus rendering the traps useless. When the ice breaks up and the spring freshets occur, the fence stakes and traps are carried away and are seen no more, unless the owner has taken the precaution of placing his baskets on the river bank, out of reach. They are usually so worn and patched when spring arrives that they are hardly

worth the trouble. With the changes in the level of the water occur changes in the local abundance of the fish. If the trap is unhappily so placed as not to intersect the main current of the river at any point, when the water falls it will cease to catch fish, and will become entirely useless. Much depends, therefore, upon the judgment and experience of the trapper.

In many localities, where the river is small and narrow, the natives, instead of making mats and driving stakes, tie huge fascines of willow-brush together, and place them side by side until the river is completely closed, except at the point where the baskets are set—one up and the other down stream. In such a case it is evident that no fish can go up or down the stream where it is intersected by the brush without being caught in the trap. Some such localities are exceedingly prolific. Ulukuk, in the valley of the Unalaklik River, is noted throughout Alaska for the great abundance of the salmon trout which are thus obtained.

We close this article with a memorandum of the catch of the Nulato fish-traps, as observed by the writer during several seasons. We preface it by mentioning that the summer fish-traps are in most respects similar to those used in winter, except that the stakes are more firmly driven, to make up for the want of the support at the surface afforded by the ice in winter; and the baskets are smaller, for greater convenience in emptying and raising them, which is done in boats, usually birch canoes.

November.—The fish-traps are set for winter. A week or two usually elapses before the trap takes any fish. The natives say that it is necessary for the resin to be washed out of the wood of which the basket and funnel are made before the fish will approach the trap. The first fish taken are the losh, which usually come in great numbers. *December.*—Suckers and losh predominate. A few white-fish and a straggling salmon are occasionally taken. *January.*—Much the same; but the white-fish begin to be more plentiful. *February.*—Losh scarce. The traps are filled with the different species of white-fish. *March.*—Much the same; but suckers begin to enter the traps. *April.*—Graylings and suckers very plenty; white-fish more scarce; a few losh taken. *May.*—A few poor white-fish and small losh are taken, but the bulk of the catch is composed of graylings. Ice carries away the traps. As soon as the river is clear new traps and gill-nets are set. *June.*—King salmon appear toward the middle of the month. *July.*—*Hoikoh*, red-fish, dog-fish, and a few white-fish. *August.*—*Keezich* and straggling salmon of the other species. White-fish, especially the *Luciotrutta* and *Muksun*, are more abundant. *September.*—Salmon trout and white-fish are in their best condition and most abundant. *October.*—Much the same; but toward the 20th of the month ice begins to form and puts a stop to fishing until it is firm enough to allow of the setting of the winter traps, which does not usually occur until early in the following month.

AGRICULTURAL IMPLEMENTS AND MACHINES, ANCIENT AND MODERN.

The history of agriculture embraces all the implements which mankind have employed in the cultivation of the earth, and the improvement made in the mechanism of agriculture from time immemorial. When men were compelled to till the soil as slaves, sowing a crop they

were not sure of reaping, and being uneducated, invention was slow. In the early history of England, every plowman was compelled by law to make his own plow. The natural result was, that the implements used were heavy, rudely constructed, and of all kinds and shapes. But the improvement of farming implements advanced in all countries where the science of agriculture was promoted until, Dodd says in 1851, speaking of the collection of agricultural implements at the Crystal Palace:

Nor did foreign countries neglect to show us to what extent similar aid is available among themselves, difficult as it must have been to send many of these ponderous machines across the wide ocean. Austria, for instance, sent us seed-harrows, carrot-drillers, seed-coverers, seed-looseners, weed-destroyers, subsoil-plows, and harrows. Belgium exhibited her seed-bags, cast-iron rollers, seed-mills, plows, harrows, winnowing-machines, weeding-machines, straw-choppers, and grass-cleaving machines. Canada contributed grain-cradles, many-pronged hay-forks, and plows. Egypt showed us her somewhat rude bill-hooks, sickles, hoes, plows, and the Novez machine for seed. From France we had plows, harrows, winnowing-machines, clover-thrashing machines, corn-cleaning machines, &c. Holland contributed seed-cradles, liquid-manure machines, swing-plows, turnip-cutters, and a very curious instrument called the *dynamostater*, to measure the strength of the action in plows. Switzerland illustrated her hand husbandry by such simple implements as pitch-forks, rakes, scythes, pruning-knives, and so forth. Prussia and the various German States sent us chaff-cutters, sowing-machines, drills, thrashing-machines, Flemish plows, subsoil-plows, water-furrow plows, and potato-mills. The United States—busy in all the fields of industry—exhibited to us some of her grain-reapers, smut-machines, horse-rakes, hay-forks, scythes, plows, cultivators, railroad horse-power, seed-planters, grain-drills, and reaping-machines.

The great difficulty the farmer labors under is, to know what implement to adopt when so many are placed before him. He hears of wonderful inventions which are entirely to supersede the old implements in every-day use, but in the majority of instances he hears that the new inventions have been abandoned—they did not answer the purpose—even before he has had time to make a trial of them. Thus it is, the agriculturist often gets bewildered with the many things placed before him, and consequently continues to go on in the old way rather than to accept the plans of others of which he knows nothing only by the many failures constantly represented to him. The question naturally arises, Why are so few inventions successful? Is it because perfection is reached and the doors of invention closed? We think not; but because, when the result is once attained, the means by which it is reached are considered complete, when in reality this is the point where inventions should commence, and the means be simplified by doing away with the useless elements, and combining the useful in the simplest manner possible, and the implement or machine be given thorough and well-appointed trials before offering it to the public.

We propose to notice some of the many inventions and improvements in agricultural implements and machines during the past year, and very briefly to note their origin.

The following is an alphabetical list of patents issued from the United States Patent Office for the year 1870, for implements and inventions having a direct bearing upon the practical operations of agriculture. It will be understood that this list contains only those cases that have been actually issued during the year, embracing about 70 per cent. of cases for which applications have been filed. The 30 per cent. remaining are either still pending or have been finally rejected for want of novelty:

Bee-hives	40	Corn-huskers	17
Cultivators	101	Cotton-pickers	5
Churns	89	Cotton-scrapers	8
Corn-shellers	16	Drags, (manure)	5
Cotton-choppers	6	Diggers, (potato)	39

Egg boxes, carriers, &c	10	Markers, (land)	4
Forks, spades, hoes, &c	37	Plows	182
Feed-cutters	6	Plows, (steam)	4
Fruit-gatherers	13	Planters, corn, cotton, potatoes, &c.	144
Fertilizers	10	Plant-protectors	22
Grain-binders	17	Pruning-tools	22
Grubbing-implements	2	Pokes, (cattle)	5
Harvesters	156	Reapers	11
Harrows	41	Rollers, (land)	8
Hay-spreaders	11	Shears for clipping animals	10
Hay-rakes, (hand)	6	Seed-sowers	41
Hay-rakes, (horse)	74	Stalk-cutters	6
Hoes, (horse)	6	Straw-cutters	19
Hay-loaders	15	Thrashing-machines	31
Hulling-machines	11	Miscellaneous	78
Hay-knives	6		
Milking devices, stools, pails, &c	40	Total	1,385
Mowers, (lawn)	11		

The improvements in these various implements and inventions relate chiefly to minor points, aiming at greater simplicity, durability, and efficiency, and thus obviating defects in the earlier constructions. A minute description of each individual subject cannot be expected in this connection. There is undoubtedly an increasing interest in bee culture, but no radical improvement has been observed in the construction of the hive. A device for emptying the comb by a centrifugal motion has contributed to a greater accumulation of honey, by the restoration of the uninjured honey-comb to the hive, to be again filled by the bees. Several attempts have been made to form an artificial comb acceptable to the bees, but hitherto without marked success. During the year considerable attention has been paid to modifications of corn (maize) planters and cultivators, to adapt them to the planting and cultivation of the cotton crop, and with prospects of ultimate success. A number of ingenious devices have been presented for the protection of choice and tender garden plants from the depredations of worms and insects in their earlier periods of growth, which will commend themselves to public use. Much attention has been paid to the dairy business, by which the cheese product has been largely increased: but this increase is due, perhaps, more to the union of small dairies, thus forming what are known as cheese factories, where the work can be more economically performed, and by experienced workmen. We need have no alarm about becoming overstocked with inventions, as every improvement introduced tends to enlarge the field for still further investigations: and the only limit to the exercise of human ingenuity and skill will be found in the most perfect adaptation of machines and implements to the performance of the labor of the world.

THE PLOW.

The plow is the most important implement in agricultural operations, and is common to all ages and countries as far as history extends. The Book of Job, one of the oldest, if not the oldest, books of the Old Testament, speaks of "The oxen *ploughing* and the asses feeding beside them;" and we find by First Samuel, xiii, 20, that the plow had a share and colter. Mr. Adam Dickson, in his works on the Husbandry of the Ancients, says:

> It is probable that I shall be considered as very partial to the ancients, if I do not allow the moderns to excel them in the construction of their plows. We are not indeed so well acquainted with the ancient plows as to make a just comparison. I shall only observe, that from the few passages in the rustic authors concerning them, it appears that the ancients had all the different kinds of plows that we have now in Europe, though not perhaps so exactly constructed. They had plows without mold-boards and plows with mold-boards; they had plows with colters and plows without

PLATE XV.

Fig. 1 JETHRO WOODS PLOW, PAT. 1819

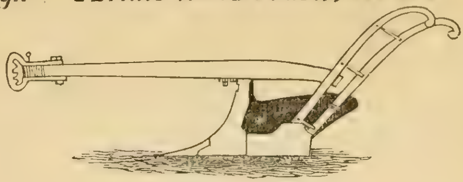
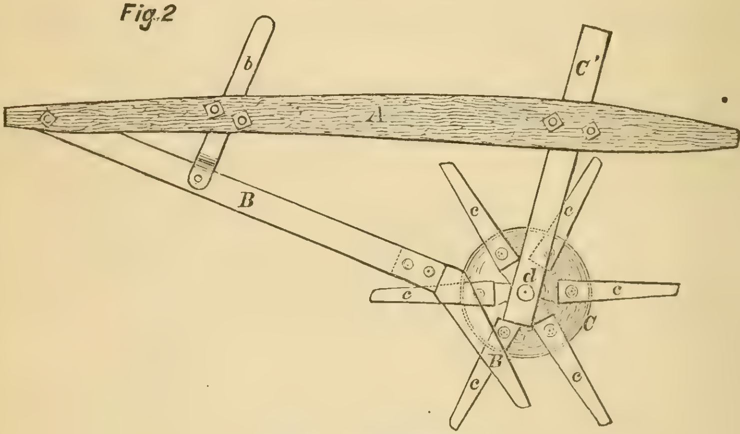
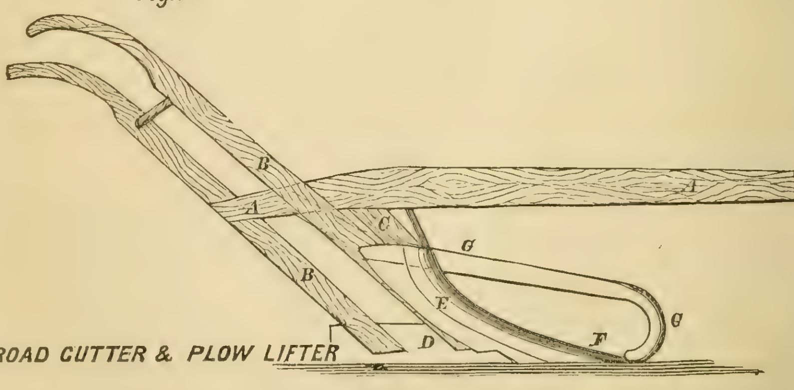


Fig. 2



PLOW ATTACHMENT

Fig. 3



ROAD CUTTER & PLOW LIFTER

colters; they had plows with wheels and plows without wheels; they had broad-pointed shares and narrow-pointed shares; they even had what I have not yet seen among the moderns, shares not only with sharp sides and points, but also with high raised cutting tops. Were we well acquainted with the construction of all these, perhaps it would be found that the improvements made by the moderns in this implement are not great as many persons are apt to imagine.

We think Mr. Dicksen must have viewed the rural mechanism of the ancients by the light of modern implements; for, while it is true that the plow has been known and used from the earliest period of ancient history, it is also true that with all the improvements the beginning of the present century found us with the rudest implements, made in the most careless manner, scarcely any two being made alike. For the most part the mold-board was hewed from wood, with old hoes, horseshoes, and thin straps of iron nailed thereon to prevent it wearing out. The land-side was wood, the bottom being covered with iron. The share was generally made of iron, with a hardened steel point. The beam was a straight stick, and the handles were cut from the branches of a tree.

There is no doubt that Ex-President Thomas Jefferson was the first to lay down the principles by which mold-boards could be made by any one with the certainty of having them all alike. This was done upon mathematical principles, as set forth in a communication to the French Institute, by which the plow should act as two wedges; one acting vertically and the other laterally, and so blended in a curve surface that the furrows should rise and turn over smoothly and continuously.

The second American who appears as an inventor of improvements was Charles Newbold, of Burlington County, New Jersey. His plow was the first cast-iron plow ever made in America, and was all cast in one piece by Benjamin Jones, of the same county, and can now be seen in the museum of the Agricultural Society of New York, at Albany. Mr. Newbold obtained a patent for his plow June 17, 1797, which was signed by John Adams, President, and Timothy Pickering, Secretary of State. The following is the specification:

The subscriber, Charles Newbold, of Burlington County, New Jersey, has invented an improvement in the art of plow-making, as follows, viz: The plow to be (excepting the handles and the beam) of solid cast iron, consisting of a bar, sheath, and mold-plate. The sheath serves a double purpose, of colter and sheath, and the mold-plate serves for share and mold-board—that is, to cut and turn the furrow. The forms are to be varied, retaining the same general principles, and to meet the various uses as well as inclinations of those who use them.

It is, however, but justice to state that Jethro Wood was the first to cast the plow in sections, so that the parts most exposed to wear could be replaced by others cast from the same pattern, by which means the iron plow became a success, and for which he received a patent in 1819, (Fig. 1, Plate 15;) but his effort to introduce his plow into public use, coupled with the great expense of making and altering patterns for the purpose of correcting defects, and for furnishing different styles and sizes of plows, consumed a handsome fortune, and the life of Jethro Wood and that of his patent terminated at about the same period, he leaving his children in penury and want, and it was not till the session of 1870 that Congress considered his claim upon the public in a bill granting to his surviving daughters the sum of $20,000, which has not yet passed.

Thus we have by Mr. Jefferson's discovery the idea of making plows by mathematical rule, although his plow when constructed contained a number of defects. So, too, with the cast-iron plow of Mr. Newbold. The defects are already seen, but the two steps were thus gained which gave to others the principles by which our plows have been made so nearly perfect as they are. Next among American inventors came Peacock, Pickering,

Davis, Hitchcock, Nourse, McCormick, and Knox. About the time Knox obtained his patent, Joshua Gibbs, of Canton, Ohio, selected a large piece of wood, and formed it as nearly as possible into the shape he considered a mold-board should be, attached to it a beam and handles, and with this rough implement commenced his labors in the field, stopping now and then to hew away with his adze that part of the mold-board which he found scoured most by the soil, until, by successive trials, he obtained a wooden mold-board all parts of which presented equal resistance to the soil in its forward movement. August 15, 1854, he obtained a patent for his mold-board, and to enable others to construct it he thus describes it in his specification:

The working surface of the mold-board consists of about one-fourth of the interior surface of a hollow cylinder. If the plow is intended to turn a surface six inches wide, a mold-board made from a cylinder with about a twelve-inch bore is desirable; but if it is intended to turn a furrow twelve inches wide, the mold-board should be made from a cylinder with a bore of about twenty-four inches; as these plows have been found to work best when they turn a furrow about as wide as the radius of the bore of the cylinder from which the mold-board was made. It has been found from experience that these plows work best when the length of the mold-board is from one and a half to twice the diameter of the bore of the cylinder from which the mold-board is made.

The advantages of this form of mold-board are also set forth in the specification as follows:

1. The plow draws easier. 2. It raises the furrow from the point and share more generally, naturally, and easily, turns and lays the furrow more uniform, smooth, and even, than any other mold-board, and leaves the trench wider in proportion to the width of the plow, and consequently the rear of the plow need not be set so wide as when a different mold-board is used. 3. It breaks the sward or furrow far less than any other. 4. The mold-board, being more arched, is stiffer and stronger than others of the same size and weight.

He claims:

Making the working surface of the mold-board in the form of a section of a hollow cylinder; the center or axis of the cylinder being parallel or nearly parallel horizontally to the base of the mold-board, substantially as described.

For the past few years no marked advantage has been gained in the form of the mold-board, although hundreds of patents have been obtained, and many applications rejected. During the past year invention has been turned to a considerable extent to "plow attachments," one of which is represented by Fig. 2, Plate 15.

The object of this invention is to produce a device which shall cut asunder all the weeds or stalks that may come in contact with the colter, and it consists in an adjustable revolving hub having radiating arms or cutters upon it, which, as the plow is drawn forward, insert themselves into the ground, making the axle with the hubs and arms revolve, and as they revolve in contact with the adjustable colter of the plow, the weeds, &c., gathering in front of the colter, must be cut by the colter. A represents the plow-beam; B the long arm of the colter, pivoted to the plow-beam A at *a*, and has arm *b* projecting upward, and pivoted to B at *a*. This arm *b* passes through a screw staple *f*, in the beam *a*, by which means the arm B and colter B are adjusted to go deep or shallow as desired. C is a hub which revolves freely on its axis *d*, and has four or more radial arms or cutters *c*, secured by screw-bolts, and as the plow, with the inclined colter, moves forward, the cutters *c* are brought successively in contact with, and pass along the edge of, the colter in such a manner that the weeds, &c., accumulating in front of the colter must be cut, leaving that part on the land to remain till the next succeeding furrow is made, and that part lying on the furrow slice being cut will be turned under by such furrow slice into the bottom of the furrow. The hub C, with its arms or cutters *c*,

is adjusted to any desired position by means of the supporting bar c', which passes through a screw clamp b'' in the beam A.

Fig. 3, Plate 15, represents a root-cutter and plow-lifter. The object of this invention is to furnish a means by which the roots may be cut, as the plow is lifted over them, and to separate the trash that may be on the ground in front of the plow. G is the cutter, the forward end of which is curved downward and rearward, so that its lower end may rest against the plow-point F. The rear part of the cutter G extends back with a slight upward inclination, and is attached to the standard C, and to the rear part of the beam A. The convex edge of the cutter upon the mold-board side is beveled off, leaving the land-side of the cutter straight, and in a line with the land-side of the plow.

CULTIVATORS.

Next to the plow in importance to the farmer is, undoubtedly, the cultivator, an implement that has taken the place of the old-fashioned hand-hoe in the cultivation of such plants as are grown in rows. By the use of this implement, a man with a span of horses is able to do the work of ten or fifteen men operating with the hand-hoe, especially in the cultivation of maize or Indian corn.

The efforts at improvement in this machine have been chiefly directed, of late years, to mere modifications, with a view of rendering it more simple and effective. Some of these machines possess a complicated structure, and are, consequently, costly, besides being liable to get out of repair. For durability and effective use, it is important that they should be made of the fewest number of parts consistent with strength and their automatic character.

Those most generally in use at the present day consist essentially of a rectangular frame mounted on wheels, and provided with a driver's seat, and have two gangs of shares, the inner shares of each gang having a lateral movement, subject to the control of the operator, to accommodate the sinuosities of the rows of plants. Most of these machines at the present time are provided with guards upon the inner sides of the inner shares to protect the young plants from being covered by the loose, falling soil.

Cultivators, or *horse-hoes*, as they were called by English farmers, were in use in England in the very beginning of the eighteenth century. They were used in the cultivation of various kinds of crops planted in rows or drills, especially the small cereals, as wheat, barley, and oats, leguminous plants and succulent roots. These being planted or sown in drills, at equal distances from six to twelve inches apart, by the use of this machine a number of rows could be cultivated at a time by having a share so adjusted as to fit the interval between the rows. The horse-hoe of that period possessed all the essential elements of the straddle-row cultivator of this day and country, and the changes it has undergone on this side of the Atlantic have simply adapted it to the cultivation of maize or Indian corn.

Jethro Tull, an English farmer who flourished in the early part of the last century, may justly be called the pioneer in the construction and use of this class of implements. The following extract from the Complete Farmer, published in London, England, in 1807, will serve to give a very correct idea of the state of the art at the period referred to:

HORSE-HOE, a very powerful tool of the hoe kind, which is much employed in the cultivation of crops that are sown or planted in the drill or row method, with sufficiently large intervals. These, like the hand sort, are of very different forms and constructions, according to the uses for which they are designed; and likewise vary much

in their weight and size, as well as the shape of the hoes or cutting parts. These sorts of hoes, from their executing the work, when constructed for the purpose, on a number of rows at the same time, have much superiority in point of dispatch, as well as in performing the operation to a greater depth and in a more perfect manner, over those of the hand kind. As by means of these hoes the mold can be more effectually stirred about the plants and the land kept more clear and free from weeds, they should be more constantly employed whenever the nature of the crop and the method in which it has been sown admit, as saving much labor and expense, as well as executing the business in a far more efficient manner.

We learn from the same work that even expanding horse-hoes were then in use, and in construction were adapted to work in drills of different widths, that is to say, the bearing wheels were adjustable upon the axle in such a manner as to accommodate the space between the rows of various crops, as wheat, barley, beans, turnips, cabbage, &c. *Drill*-machines, which have been long in use, were converted into *horse-hoes* by removing the drill teeth and substituting cultivating shares, and so adjusting them as to fit the spaces between the rows of growing plants. It was also discovered that soils of different textures will require to be hoed with shares of different form and size, and that nothing but experience in the field can point out that which is best adapted to any particular soil.

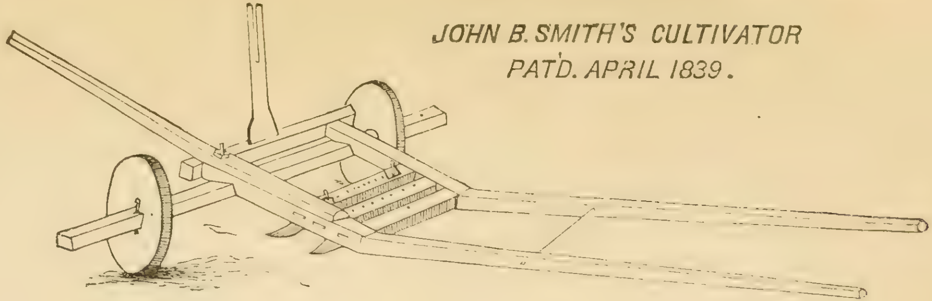
In Loudon's Encyclopedia of Agriculture, sixth edition, page 125, we have the following statement:

In England, from the Restoration to the middle of the eighteenth century, very little improvement took place, either in the cultivation of the soil or in the management of live stock. Even clover and turnips (the great support of the present improved system of agriculture) were confined to a few districts, and at the close of this period were scarcely cultivated at all by common farmers in the northern parts of the island. From the Whole Art of Husbandry, published by Mortimer in 1706, a work of considerable merit, it does not appear that any improvement was made on his practices till near the end of the last century. In those districts where clover and rye-grass were cultivated, they were cut green and used for soiling as at present. Turnips were sown broadcast, hand-hoed, and used for feeding sheep and cattle, as they were used in Houghton's time, and are still in most districts of England.

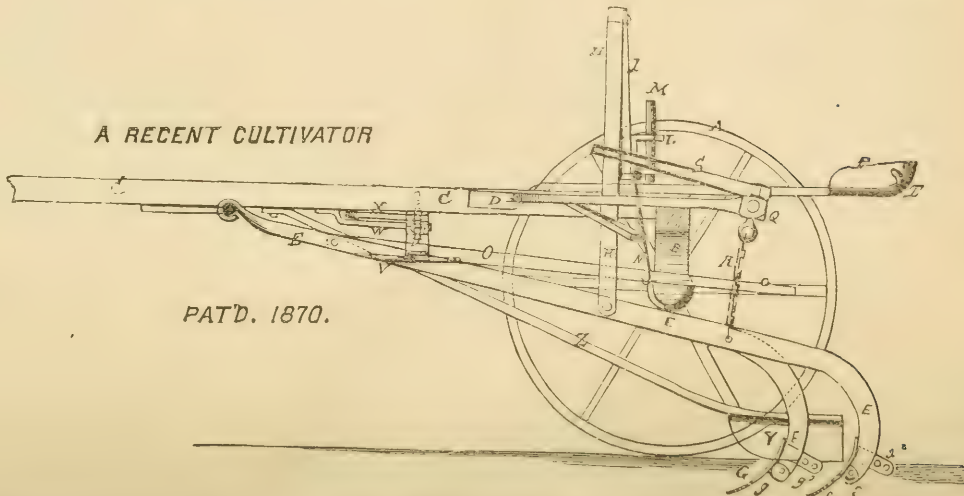
In the beginning of the eighteenth century a considerable improvement in the process of culture was introduced by Jethro Tull, a cultivator of Berkshire, who began to drill wheat and other crops about the year 1701, and whose Horse-Hoeing Husbandry was published in 1731. In giving a short account of the views of this eccentric writer, it is not meant to enter into any discussion of their merits. It will not detract much from his reputation to admit that, like most other men who leave the beaten path, he was sometimes misled by inexperience and sometimes deceived by a too sanguine imagination. Had Tull confined his recommendations of drill husbandry to leguminous and bulbous-rooted plants generally, and to the cereal gramina only in particular circumstances; and had he, without puzzling himself about the food of plants, been contented with pointing out the great advantage in pulverizing the soil in most cases, and extirpating weeds in every case, he would certainly have deserved a high rank among the benefactors of his country. A knowledge of his doctrines and practice, however, will serve as a necessary introduction to the present approved modes of culture. * * * * The extraordinary attention Tull gave to his mode of culture is, perhaps, without a parallel. "I was formerly at much pains," he says, "and at some charge, in improving my drills for planting the rows at very near distances, and had brought them to such perfection that one horse would draw a drill with eleven shares, making the rows three inches and a half distant from one another, and at the same time sow in them three very different sorts of seeds, which did not mix, and these, too, at different depths."

It will be seen by these quotations that the broad idea of cultivating more than one row of plants at a time by horse-power did not originate in this country. What, then, are the improvements in this implement claimed by American inventors? Perhaps the first and most important is the provision of a driver's seat upon the frame of the machine, and the adaptation of the cultivating devices by which they were brought within the perfect control and guidance of the operator. Invention does not often make gigantic strides; and hence we see that little by

PLATE XVI.



JOHN B. SMITH'S CULTIVATOR
PAT'D. APRIL 1839.



A RECENT CULTIVATOR

PAT'D. 1870.

little has been added to the original idea, and it is under this influence that farmers have reached the high standard now presented in cultivators.

Thirty years ago, a man with a hand-hoe could, by the aid of a horse and plow, for plowing furrows between the rows of corn, cultivate an acre in a day. Now, with a span of horses, and one of our best riding cultivators, fifteen acres can be accomplished, and this with almost as much ease and comfort as a day's journey in a buggy.

In looking back over the last thirty years, and tracing from year to year the improvements that have been made in this implement, to more perfectly adapt it to the cultivation of maize, or Indian corn, it would seem that this machine had almost reached perfection, and that there is little more that is desirable. Looking at the subject from another stand-point, however, we are forced to acknowledge that the field for advancement is constantly enlarging, and that every new improvement introduced only widens the area for others.

Let any one trace the successive steps that have been taken, from the initiative idea of Jethro Tull, in the year 1701, to the present time, and consider in this connection the liberal policy of the Government in granting protection for improvement in art, and he will be no longer in doubt as to the cause of the issue of so many patents for improvements in this and kindred inventions.

It has already been said that different soils require different modifications of implements for their management. Now, a farmer who purchases a cultivator that is well adapted to a light, sandy soil, while his own may be heavy, tenacious, or stony, soon finds that the machine, in the form of its shares, and perhaps in some other details, is not exactly what he desires, and in order to improve his machine he makes changes in this or that particular, and finds its work more satisfactory, and, believing that he can benefit the public as well as himself by his ingenuity, applies for and obtains a patent for his invention. Others follow his example in an effort to improve their agricultural machinery, and thus little by little is added to the great and constantly accumulating store of knowledge; and it is in this way that inventions grow up from small beginnings to the highest state of perfection hitherto attained.

It should not be understood by this remark that every alleged improvement is valuable. There are many for which letters-patent have been issued that are scarcely heard from after their unobtrusive birth. It is only by actual test in the field that their value can be established. And again there may be, and no doubt are, many meritorious inventions that are never put to a practical test, simply from the pecuniary inability of the inventor to bring them into public notice. It would, perhaps, be thought invidious should we attempt to draw a comparison between cultivators still operating under unexpired patents with older inventions. We will therefore merely give an example of the earlier conceptions in this department in our own country, and leave the subject of comparison to the reader. (Plate 16.)

We cannot leave this branch of our subject without allusion to another fact that seems to need some explanation. It is sometimes said that patents are refused for meritorious inventions. This is undoubtedly true, at least in some cases. Original inventors are not always the *first* inventors. For example, the straddle-row cultivator was invented as long ago as 1701, but this fact may have remained unknown even to the present day to a great majority of inventors of agricultural implements in this country. In such a case a broad claim must, of necessity, be

refused. Again, an invention may contain two or more claims, while but one is really patentable. In the examination, references are cited against those only that are old, and a patent refused on that ground; whereas, if the inventor would amend by erasing the anticipated claims, a patent would be issued. In other cases, in which the applicant is entitled to a patent, the specification is so imperfectly prepared that, should a patent be issued, it would be worthless from lack of perspicuity. Some cases are fairly and properly rejected upon reference. When this is the case, the applicant has no cause for complaint. It is the spirit of the patent laws to grant full protection to every first and original inventor.

GRAIN-DRILLS AND CORN-PLANTERS.

From history we are led to believe that the first, and for ages the only, mode of sowing seed was by hand, by which the seed was used with but little economy, and scattered with but little precision. In the East it was the custom to prepare the soil by treading it with the feet of the ox and the ass. (Isaiah, xxxii, 20; and Matthew, xiii, 3.) History, however, fails to tell us who invented the first seeding-machine, or even where it was made, yet it does tell us that a rude kind of drill has been used from a very remote period. The husbandmen of China, Japan, Arabia, and the Carnatic, have drilled and dibbled in their seed from time immemorial. (Quarterly Journal of Agriculture, vol, 1, page 675.) There was invented in Germany, about the year 1056, a drill-plow, the construction of which is unknown. In England, the first patent for a seeding-machine was granted to Alexander Hamilton, November 27, 1623, which was the twenty-seventh patent granted under the old law. The construction of the machine is not described in the specification, nor is a plate furnished; accordingly we have nothing to guide us in arriving at an understanding of what the machine was. All we can learn is set forth in the following words, copied from the title of the invention:

> A spiall privilidge graunted to Alexander Hamilton, esqre., (for twenty-one years,) of the sole practise w[th]in England, Ireland, and the dmons thereof, of a newe invencon, by him invented and perfected, as well for the ploughinge, as for the harrowinge, sowinge, seedinge, and settinge of corn and grain at greater ease and w[th] more pfett than by anie other means heretofore used.

About the year 1733, Jethro Tull invented a machine to sow wheat and turnip seed in drills, three rows at a time, and to Tull is given the credit of inventing the cylinder with cavities in the surface of the same for feeding the seed. About the year 1790 James Cooke invented a machine by which manure was deposited with the seed. It is observed that while in later English inventions machines were constructed to plant several drills at a time, and also to adjust the machine so that the drills would be a greater or less distance apart, yet until William Grounsell obtained his patent, June 12, 1839, it does not appear that a machine was constructed to drop the grain in hills, or at intervals, the distances of which could be regulated at will.

In the cultivation of corn and other cereals in this country, in the earlier times, the condition of the newly cleared land precluded the employment of machinery in the planting and sowing of seeds; and hence corn was planted by hand, and wheat and other small grains were sown broad-cast. Machinery could not have been made available to any great extent for this purpose, in consequence of the presence of roots and stumps of trees of the primitive forests; and it was not until the lands of the New England, Southern, and Middle States had become cultivated, and immigration extended to the prairies of the West, that

a necessity for this class of agricultural machinery was felt. The first patent granted for a corn-planter in this country was to Eliakim Spooner, of Vermont, January 25, 1799; the first for a cotton-planter to Christopher Ford, of Virginia, May 26, 1825. From 1800 to 1828 there were but few patents granted for seeding-machines of any description. August 13, 1828, a patent was granted to Austin H. and Levi Robbins for a machine for planting different seeds. The machine is placed upon a frame and wheel similar in construction to that of a common wheel-barrow, and was pushed over the ground, the operator walking behind. A writer, speaking of this machine, in November, 1828, sets forth its value as follows:

> There can be no difficulty in the application of this machine to the planting of any kind of seeds, and any number of them at a time, and at any required distance, as fast as a man can walk. When the rows are set four feet apart one way and eighteen inches the other, there is no difficulty, nor is it a very hard day's work, for a man to plant ten acres after the ground is properly prepared to receive the seed.

August 22, 1828, a patent was granted to Orson Starr, of Richmond, Ontario County, New York, for a "machine for planting grain and other seeds." This machine differs from the one above mentioned in several particulars. It has handles and a beam similar to the common plow, supported from the *rear* by wheels; beneath and about the center of the beam there is a shovel plow to open the furrow for the reception of the seed, and to the rear of the machine is attached an iron scraper to close the furrow after the seed is dropped. On the top of the beam is placed a hopper in which a cylinder is made to revolve by suitable mechanism. The cylinder is made of sheet iron; the edge of it is perforated at suitable distances to receive pieces of metal which act as valves working upon a pin, and forced out by springs contained within the wheel, so as to project beyond its periphery, but capable of being forced in when passing the ends of the slot in the bottom of the hopper. These valves contain the quantity of seed to be dropped in each hill, and may be more or less numerous according to the distance at which they are to be dropped in the furrow. For a full description and representations of the two last-named machines, see the Franklin Journal, vol. 6, second series, pages 343 to 348.

Numerous patents have been taken out within the past few years for seeding machines, which may be divided into the following classes, viz: 1st. Broadcast seeders, by which the seed is sown broadcast over the land. 2d. Grain drills, by which the seed is deposited in drills. 3d. Corn planters, by which the seed is, for the most part, planted in hills. 4th. Cotton planters. 5th. Potato planters. Not a few persons have attempted to combine all the above-named machines in one, and besides add a plow, harrow, cotton-chopper, and cultivator. It is enough to say that the attempt has been a failure. A machine can easily be so arranged as to be changed from a grain drill to plant in hills, by diminishing the number of cavities on the dropping wheel; then, by removing the dropping mechanism the machine may be used as a wheel cultivator, a wheel plow, or a harrow, or even a land-roller may be attached; but to plant cotton or potatoes a general change in the whole dropping mechanism would be required. Cotton seed cannot be dropped with accuracy either by a slide or by a revolving cylinder, owing to the lint with which the seed is covered. It requires a cylinder (revolving in the bottom of the hopper) provided with arms, slightly curved in the direction in which they move, so that as the arms pass through a slot in the bottom of the hopper a certain quantity of the seed will be carried with them. Potatoes could

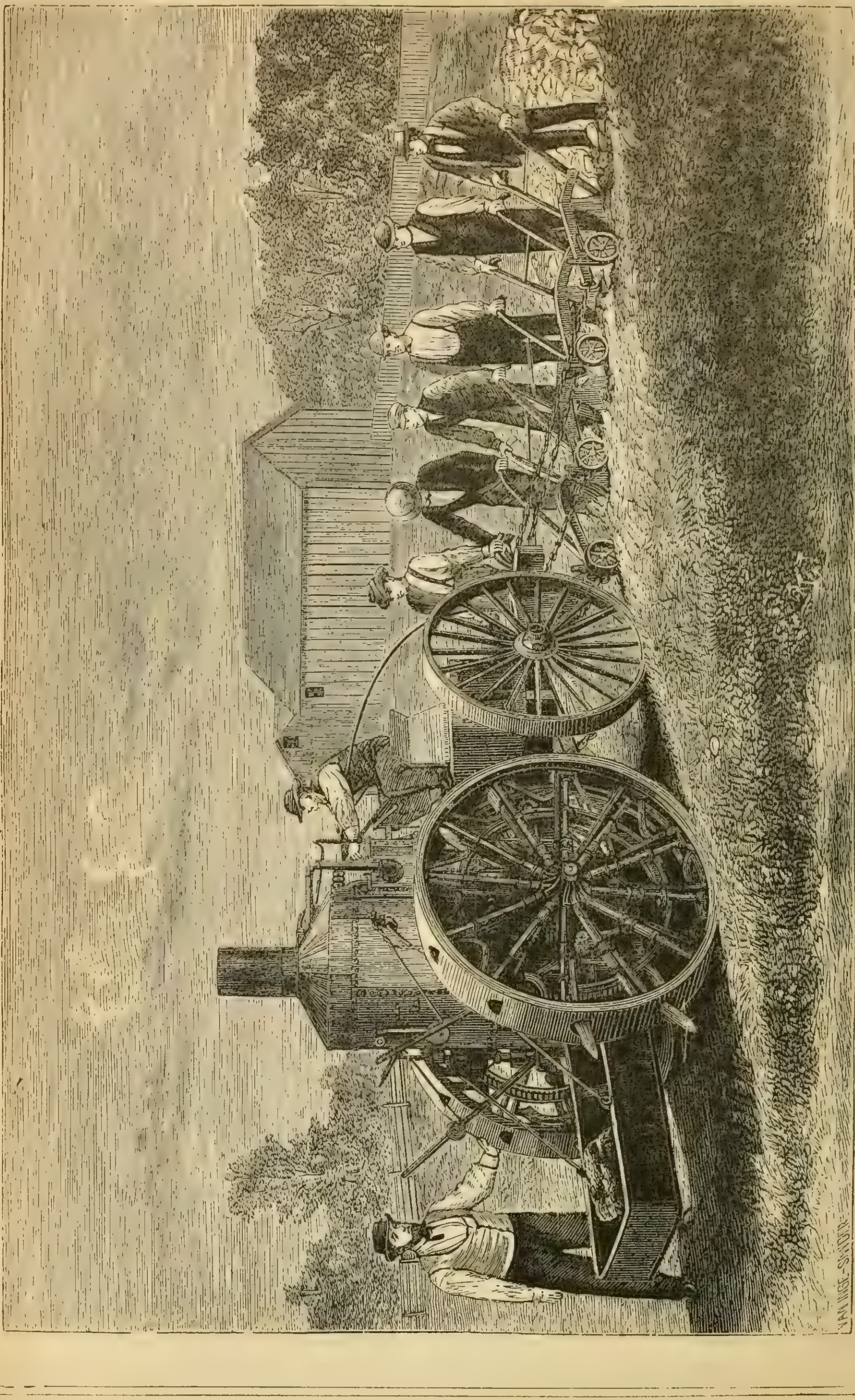
not be planted because the whole dropping mechanism is too small. To plant potatoes, a cylinder with arms similar to the cotton planter is required, but placed higher in the hopper. Each of these arms (being sharp at the end) picks up a potato as they revolve, the cylinder being so arranged as to allow its arms to pass through the side of the hopper (instead of the bottom, as in the cotton planter,) into a tube or spout where the potatoes are deposited by the arms of the cylinder, and thence conveyed to the ground.

POTATO DIGGERS.

There is no agricultural implement (except, perhaps, the steam plow) requiring more improvement than the potato-digger, it being very doubtful if there ever was one constructed which can be pronounced a success, among the many hundreds upon which a vast amount of money and labor have been bestowed, although reports have been received of satisfactory work under favorable circumstances. At the beginning of the present century we find that in England the mode of taking up the potatoes depended very much upon the manner in which the seed was planted. If planted in drills, a furrow was turned from each side of the drill, and then that part of the drill in which the potatoes were lodged, was turned over with a plow; or after the furrows were turned from each side of the drill, the middle was turned over with a hand-fork. At other times a spade was used for the same purpose. If the potatoes were planted in hills, which was rarely done, a fork or spade was the only implement used. There was also used in England, about the beginning of the present century, "an implement for tearing the furrow to pieces and laying bare the mass of the crop," consisting of the ordinary plow-beam and handles with a crosspiece attached to the rear of the beam, to which was affixed a diagonal harrow having three or four vertical teeth. After this harrow had been once over the ground, the potatoes unearthed by the operation were picked up, and then the ground was cross-harrowed and the potatoes uncovered by this second harrowing were gathered. While at this time, in our own country, potatoes were unearthed generally by the common hoe, we believe the idea of digging, separating, and gathering potatoes by one operation—by passing once over the ground—originated here, and the machine by which the same was to be done was invented and constructed by an American. While the first efforts in this direction were not entirely successful, those who have the most nearly attained success within the past few years have employed the same mechanism, operating upon the same principle, and constructed in substantially the same manner, as the first machine made for this purpose.

Among the first inventors in this line was Levi Rice, of Robbinston, Washington County, Maine, who obtained a patent for his machine June 29, 1833, which he describes as "a machine for furrowing, dropping and covering, and for digging potatoes." The machine consists of a scoop or shovel at the extreme front of the frame, which raises the potatoes and dirt together, which, as the machine is moved forward, pass on an endless belt or apron, while a roller shakes the same, causing the dirt to fall through the open belt or apron to the ground, while the potatoes pass along to the end of the apron and fall into a box placed on the rear of the frame. The rear of the frame is supported by an axletree and wheels, the wheels containing spikes to keep them from slipping. The apron is moved by cog wheels, one of which is placed on the axletree and the other on a shaft or cylinder above, around which the apron moves. There are levers by which the shovel or scoop is regu-

PLATE XVII.



REDMOND'S STEAM PLOW.

lated, to take more or less earth as required. The whole is supported by a triangular-shaped frame, to the forward part of which the shovel or scoop is attached, which rests on the ground, while the rear part is supported by the axletree and wheels before mentioned. Beneath and to the frame are attached three plows, placed in the form of a triangle, to be used when the machine is required as a planter. The forward plow opens the furrow for the reception of the seed, and the other two cover the furrow after the seed is dropped. The dropping mechanism is not described by the inventor, and the original papers were destroyed by fire when the United States Patent office was burned. While the principle above set forth has been generally followed in the construction of potato diggers, it is deemed proper to remark that in some machines a revolving disk has been substituted for the shovel or scoop and apron. These disks have been used in a variety of positions; as, for instance, being placed upon a longitudinal shaft revolving in the center of the frame and operated by suitable mechanism. In other machines the disk is placed upon a vertical shaft, and in others upon a shaft extending over the rear of the frame and inclined to the side of it at an angle of about 45°. The general construction of these disks consists in a hoop placed upon the shaft conveying the power. To this hoop are bolted, or otherwise firmly secured, arms or tines, which are either curved, straight, or spiral, as desired, arranged to go beneath or through the hill or drill, according to the construction of the machine. Others have used a common shovel-plow, provided with handles and beam, with a rack pivoted to the rear of it. This rack is agitated by a wheel with projecting arms, which strike a friction roller pivoted to the rack, thus giving to the rack the necessary motion for separating the earth from the potatoes.

As before remarked, none of these machines have been noted for success, and we instinctively ask, Why? Can it be that it is impossible to construct a successful potato-digger? We think not, but believe that one could be constructed upon the general principles already applied. It must be considered, however, that we have a treacherous soil to deal with, which, as it is agitated, divides itself into minute particles, and introduces itself into every opening of our mechanism with which it comes in contact, and serves to retard motion. Another fault is, that the earth is raised too high, which requires double the power that should be required to do the work. The potatoes must be raised, it is true, but the less we raise the earth the less power we require. Another useless expenditure of power is in driving ratchets and pawls and operating springs; and, still further, the general construction of the machine is too cumbersome, and we might add that in many instances the ground is not properly prepared before planting.

STEAM PLOWING.

This subject has been so fully discussed in the reports of the last three years that a few words will suffice to convey all the information in our possession upon the subject of recent attempts at improvements. For the last year but two applications for patents have been filed for steam plows, and these are based upon suggestions set forth in an article upon this subject in the report of 1867. These applications show that the subject has been considered in its proper light, and it is believed with results favorable to the final solution of this important question. But the problem is not yet fully solved. It requires time, the exercise of inventive genius, and a large outlay of capital, to finally settle the ques-

tion of the utility and practicability of the application of steam power to the cultivation of crops.

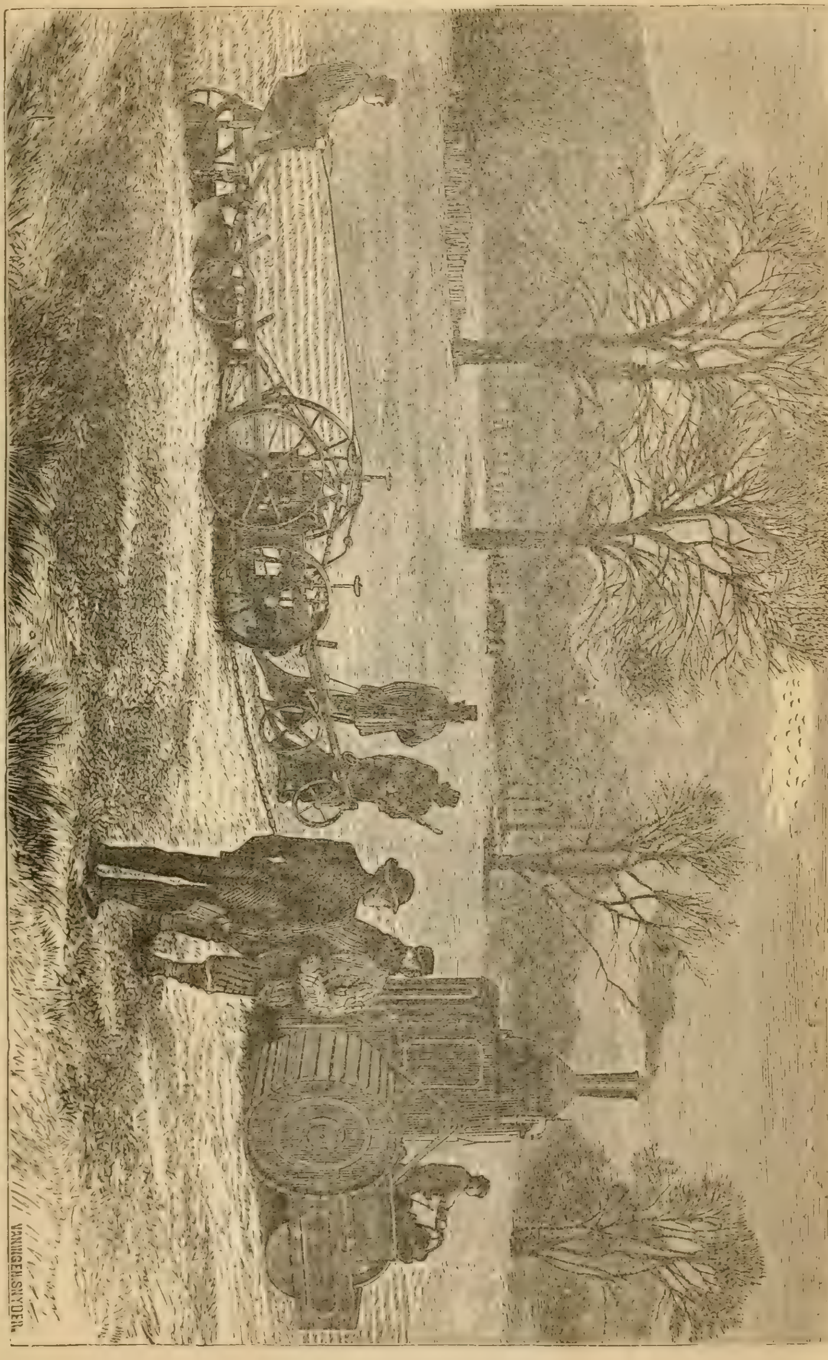
Redmond's steam-plow.—Plate 17 represents a steam-plow patented by Owen Redmond, of Rochester, New York. The illustration is copied from a photograph of the machine at work in the field; a gang of six plows, designed to go with the engine, has since been constructed, intended to be operated by one man, who may also be the fireman. The machine is five feet ten inches wide and weighs less than 5,000 lbs. The boiler is placed directly between the two driving-wheels. The tender carries a two-barrel water-tank, upon which is the seat of the engineer. The hold of the engine on the ground is secured by the protrusion of a series of fluke-shaped anchors through the rim of each wheel, which are pressed into the ground by a cam on a friction roller on the stem of the anchor, the cam being held by a coil spring, which gives if the anchor meets with unusual obstruction. The force required to drive the anchors is a lifting one on the wheels, tending to prevent them from sinking into the soil. It is claimed that this machine can plow three acres an hour.

Lord Dunmore's steam-plow.—Plate 18 is an illustration of Lord Dunmore's three-furrow balance steam-plow with traction engine, exhibited in the presence of a committee of the Royal Highland and Agricultural Society. Lord Dunmore had been interested and successful in experiments in cultivating, pulling out tree-roots, carrying timber, hauling railway luggage, cutting hay and straw, working saw-mill, pumping water, and various other useful work, in which successful competition was maintained with horse labor; and he determined to test fully its capabilities for plowing, but was unsuccessful until he invented the three-furrowed balance-plow shown in the engraving. The experimental trial, after a heavy fall of rain, upon land untouched by plow share for forty years, gave much promise of future success. It cut clean and straight furrows six inches by ten inches, five acres per day, at a cost of 19*s.* 9*d.*, or about $1 per acre.

FOOD PRODUCTS OF THE NORTH AMERICAN INDIANS.

An inquiry into the means of subsistence of the aborigines is attended with much curious interest. It discloses many plants almost unknown to the people, and very little known to science, which may be utilized in the arts and in food products. This paper has been prepared with reference to so probable a result. The articles of food hereafter enumerated may not be employed by and may be unknown even to such tribes as receive annuities, or which, being partly agricultural, dwell in villages, and are otherwise provided for; but the wilder Indians, who roam over thousands of square miles of territory, are almost entirely dependent upon them for existence. Their habits have naturally become nomadic; the camping-ground at one place being exhausted, a removal to another is imperative. Sometimes in autumn, when fruits and grain are ripe, the women gather a small store for winter. Exposed to the vicissitudes of the weather, improvident and reckless of the future, depending on their bows and arrows, their nets and traps, gorging themselves when the opportunity is offered, and stolidly submitting to starvation in seasons of scarcity, and at all times indolent, the art of cultivating a crop is either unknown to or despised by them. When the

PLATE XVIII.



LORD DUNMORE'S STEAM PLOW.

larger game fails, with senses sharpened by hunger they snatch the smallest and vilest animals and insects, or insipid and innutritious roots and grass. Nothing, however coarse and filthy, is rejected; there is nothing that grows out of the ground or that creeps upon its surface which they will not devour, unless it is known to be poisonous. The Indian's dwelling is sometimes a wigwam; not unfrequently the hollow of a tree or a cave in the rocks; even a pile of brush to the windward of his campfire is sometimes the only shelter of his family. It is thus evident that in his mode of foraging he resembles in his nature the more savage animals which share the forests with him, and which frequently fall a prey to his ferocity, as he does sometimes to theirs.

ROOTS AND TUBERS.

Ground-nut, (*Apios tuberosa.*)—The tuber of this common plant, which grows on the banks of streams and in alluvial bottoms, is the true *pomme de terre* of the French, and the modo, or wild potato, of the Sioux Indians, and is extensively used as an article of diet. When properly boiled it is by no means unpalatable. It should not be confounded with the ground-nut of the South.

Dill, (*Anethum graveolens*,) called by the Snakes and Shoshone Indians yampah.—This spindle-shaped root grows in low, timbered bottoms, and is esteemed as the best of its kind when used for food. It is analogous to the parsnip, and is an article of commerce among the Indians. The seeds are used to flavor soup.

Milkweed, (*Asclepias tuberosa.*)—The stem of this plant expands under ground into a tuber of considerable size, which is boiled for food. The flowers are odoriferous, and the Sioux of the Upper Platte River prepare from them a crude sugar by gathering them in the morning before the dew is evaporated. They also eat the young seed-pods of the plant, after boiling them with buffalo meat. Some of the Indians of Canada use the tender shoots of this species as we use asparagus.

California horse-chestnut, (*Æsculus Californica.*)—An ornamental dwarf tree, producing large quantities of fruit. To render the nuts edible, after being pulverized, water is freely used to remove their disagreeable, bitter taste, and they are then made into bread. The Indians of California use this food in large quantities.

American aloe, (*Agave Americana.*)—This plant is commonly called mescal, and forms one of the chief articles of food of the Indians of New Mexico, Arizona, and Sonora in Mexico. It grows upon the most barren mountains, and is taken for food when old enough, at any season of the year. It is in its prime, however, when about putting forth its flowering stem. To prepare it for use, the leaves are cut off at the base, or crown, leaving a hard, white, bulbous mass, measuring one or two feet in circumference, having a flavor like chestnuts, but somewhat peppery. It cannot be eaten in its fresh state, but must be cooked. For this purpose the Indians dig a hole or pit ten to twelve feet in diameter and three feet deep, lined with stones, upon which a fire is made and the stones thoroughly heated. The fire being removed, a layer of damp grass is placed on the rocks; then the bulbs, which are covered with the tender inside leaves taken from the crowns; a layer of grass is placed over these, and over all a thick coating of earth. After three days the contents of the pit are found to be thoroughly baked, and converted to a sweet, juicy article of food, a favorite for use in camp, of a brown color, and resembling pears in taste. It is used as an article of commerce, and when the writer was at Camp Grant, Arizona, the Apaches

often brought it to the post for trade, where it found a ready market, as it is not only pleasant to the taste, but acts as an antiscorbutic, so necessary at military posts in the Territory of Arizona. Cut up into slices, it is easily dried and retains its sweetness for years, as evidenced by specimens in the Smithsonian Institution, now three years old. If the crown of the *Agave* be charred to blackness and mingled with water, a fine black paint is produced, which is used by the Apaches to paint their faces. The leaf, when washed and dried, is employed by the Indians for smoking, like tobacco; but being sweet and gummy, it chokes up the pipe. The Hualipais, of Arizona, press the roasted heart and leaves of the mescal into thin cakes, thirty inches long and eighteen broad, and trade them to the Moquis Indians for corn. In this form it has a shining, granulated look like opium. The crowns are sometimes baked in hot ashes, but are not so good as when baked in the pit. It is a common practice in uncovering a mescal pit to collect the roasted leaves into suitable bundles and press them flat. They soon dry and are very sweet, but inferior to the crown. These roasted leaves being of a fibrous nature entangle a white man's teeth to an objectionable extent. The leaf has a dirty, black, stringy look, but it is the favorite food of the Apaches, and when they are at war or on the hunt packages of it are tied up with strings and carried around the person, or made fast to the saddle, and are their only subsistence. A fine mescal spirit is prepared by the Papajos and Apaches from the roasted heart of the *Agave Americana*. The sugar is developed by heat during the roasting, and when taken out of the pit the heart is cut into pieces, and put into hide bags or earthen jugs. Water is then poured over it, fermentation follows, and at the end of a week it is distilled. The process is carried on in secret. It is a strong, fiery drink, but not half so injurious as modern whisky. It is much used by Mexicans, and will tempt an Indian to any undertaking which promises to furnish a supply. The wasted pulp, when cut up, mixed with water, and boiled, forms a fine sirup, and when dissolved in cold water forms a pleasant drink and an excellent sauce to the usually very dry and insipid articles of Indian food. Although the roasted root is very dark, the distilled spirit is of a clear yellow color. It cannot be adulterated with water without immediately rendering it ropy and distasteful, the water precipitating some mucilaginous matter or resin contained in it.

The leaves of this plant afford an excellent, strong, and rather coarse fiber. The Indians of Arizona and Southern California use it extensively, preparing it either by drying the leaves and beating the dry pulp from the fiber, or by using the fresh leaves and soaking in water until the rotten pulp falls off the fiber. On one occasion, when the writer was out against the Apaches with a scouting party, twenty of whom were Papajos, our Indian allies, when camping during the day, would gather the dead plants after they had bloomed, beat out the dry pulp from the fiber, and twist the latter into picket ropes; and, on the expiration of the scout, they had many lariats for sale made of this article.

Balsamorrhiza incana and *B. helianthoides*.—Both of these species have thick roots, which are eaten by the Nez Perces Indians without previous cooking.

Pimple mallow, (*Callirrhoë pedata*.)—The root of this plant resembles a parsnip, and is used as food by the Indians of Nebraska and Idaho.

Wild sago, (*Calochortus luteus*, Fig. 5, Plate 1.)—The Utahs call it sago. The root is the size of a walnut, very palatable and nutritious. The Indian children of California, Utah, and Arizona prize it as the

PLATE XIX.

[PLATE 1 INDIAN FOODS.]

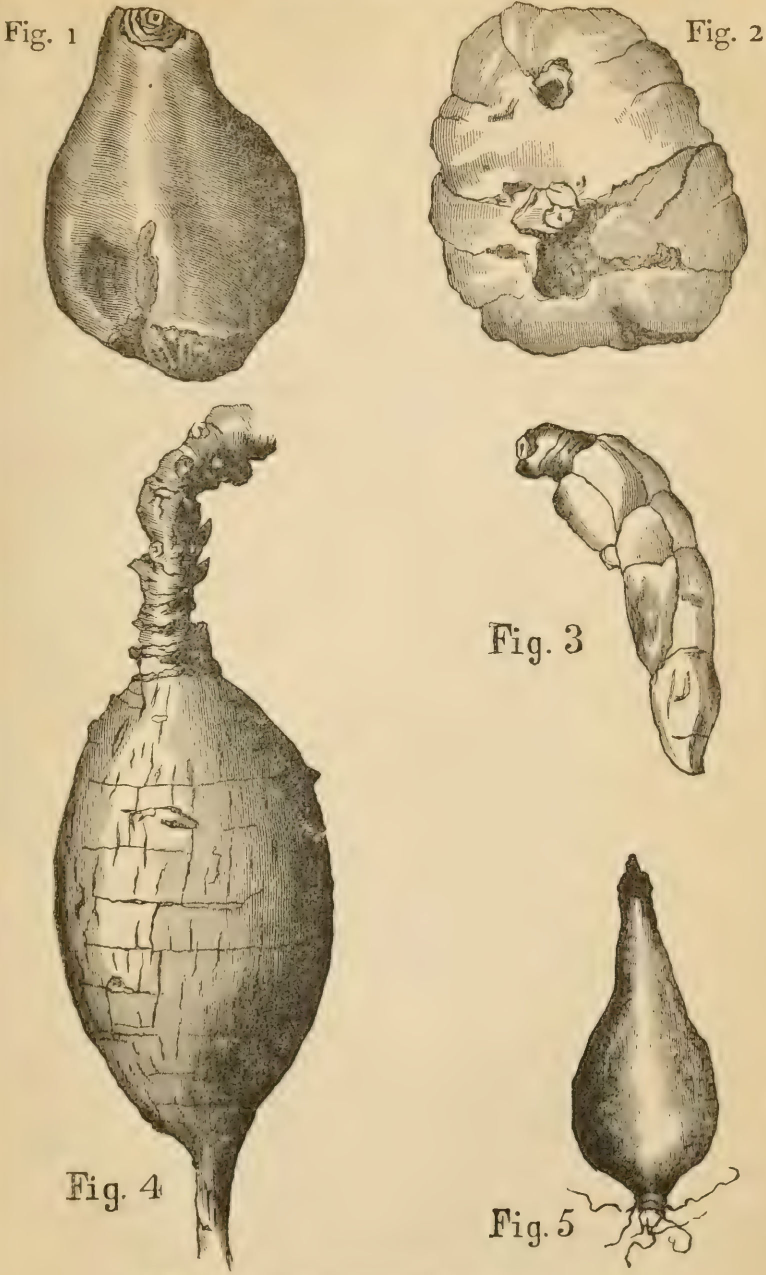


Fig. 1. Kamass root (*Camassia esculenta*).
Figs. 2 and 3. Kouse root (*Peucedanum ambiguum*).
Fig. 4. Prairie potato, or bread root (*Psoralea esculenta*).
Fig. 5. Wild sago (*Calochortus luteus*).

children of the whites do confectionery. The Mormons, during their first years in Utah, consumed this root extensively.

Edosmia montana.—The Nez Perces Indians collect the tuberous roots of this plant and boil them like potatoes. They are the size of a man's finger, of a very agreeable taste, with a cream-like flavor.

Licorice, (*Glycyrrhiza lepidota.*)—This American form of licorice root is eaten by the Indians of Alaska and the northwestern States.

Wild artichoke, (*Helianthus tuberosus.*)—Very common on the river banks of the St. Peter's and St. Croix, and is much eaten by the Dakota Indians.

Helosciadium Californicum.—The tubers of this species form one of the dainty dishes of the Oregon Indians. They are black, but when boiled like potatoes they burst open lengthwise, showing a snowy-white farinaceous substance, which has a sweet, cream-like taste, with a slight parsley flavor. It is an excellent root, the cultivation of which might prove useful among the whites.

Wild potato vine, (*Ipomœa leptophylla.*)—This showy plant of the dry deserts of the West is commonly called man root, or man of the earth, being similar in size and shape to a man's body. The Cheyennés, Arapahoes, and Kiowas roast it for food when pressed by hunger, but it is by no means palatable or nutritious. Its enormous size and depth in the ground make its extraction by the ordinary Indian implements a work of much difficulty.

White Lewisia, (*Lewisia redivira.*)—The Indians of California call it spatulum. The root is large and fusiform, the outer portion of a dingy color, the inner white and farinaceous. It abounds in concentrated nutriment, a single ounce of the dried article being sufficient for a meal. It is worthy of cultivation.

Yellow pond lily, (*Nuphar advena.*)—The roots grow four or five feet deep in water, and Indian women dive for them, obtaining large quantities, one or two feet long. They are very porous, slightly sweet and glutinous, generally boiled with wild fowl; but often roasted. Muskrats store large quantities of these roots in their dwellings for winter use, which the Indians contrive to steal. The plant is called tah-wah-pah by the Dakota Indians. The seeds form an important part of the diet of the Klamath Indians of California, and when pulverized they are made into bread or gruel, but are often parched and eaten as pop-corn.

Ginseng, (*Panax horridum.*)—Some of the Alaska Indians believe that the root of this plant, consumed by their sorcerers, gives them power over others. It is therefore an important ingredient of the medicine-man's commodities.

Kouse root, (*Peucedanum ambiguum*, Figs. 2 and 3, Plate 1.)—The root of this plant is dug in April or May when in bloom. It grows on hills and mountains which are so poor that grass will not grow upon them. When fresh it is like the parsnip in taste, and as it dies becomes brittle and very white, with an agreeable taste of mild celery. It is easily reduced to flour. When its brown epidermis is removed, innumerable small dots are revealed. Both the roots and the flour will keep several months. It is sometimes called bread or biscuit root by travelers, and Kouse root by the Indians of Oregon and Idaho. The Canadians know it by the name of *Racine blanc*. After the bread has been made a short time, its taste is not unlike that of stale biscuits. When the roots have been pounded fine, the flour is pressed into flat cakes, one foot wide, three feet long, and from a quarter to half an inch thick, of an oblong rectangular form, with a hole in the middle by which they are fastened on the saddles when traveling. The cakes have a ribbed appearance,

caused by being laid on sticks stretched over the tent fires, for the purpose of smoke-drying or baking the bread. When broken up the bread has a coarse granulated appearance, especially when not ground very fine, and is very insipid.

Prairie potato or *bread root*, (*Psoralea esculenta*, Fig. 4, Plate 1.)—It is also called Indian turnip, *pomme de prairie* of the French, and tip-sin-nah of the Sioux, who use this root very extensively. It is generally the size of a hen's egg, of a regular ovoid shape, with a thick, leathery envelope, easily separated from its smooth internal parts, which become friable when dry, and are readily pulverized, affording a light, starchy flour. It is of a sweetish turnip-like taste, is often cut in thin slices and dried for winter use, and is very palatable, however prepared. The Indians of Kansas and Nebraska consider this root an especial luxury. The Indians of the St. Croix River offer these roots as a peace-offering to the Great Spirit.

Brake or *bracken* (*Pteris aquilina.*)—The root of this species of fern is eaten by several of the northern tribes of Indians. It is about the size of a man's finger, externally black, and rather rough, and easily separated from the heart, which is white. After being roasted it resembles, both in appearance and flavor, the dough of wheat. It has a pungency which is disagreeable to the whites, but by the aborigines is much relished, and it proves to be nutritious.

Cattail flag, (*Scirpus lacustris.*)—The root of this plant is much eaten by the Indians of the Upper Missouri. In California it is called tule root, and is a great favorite, whether raw, or pounded and made into bread. The flour is white, sweet, and very nutritious. The roots are sometimes bruised, mixed with water, and boiled, when a good sirup is produced. The Cocopah Indians, of Arizona, before starting on a journey procure some of these roots to chew as a preventive of thirst, and at the same time to afford them nourishment. The roots resemble artichokes, but are much longer.

Arrowhead, (*Sagittaria variabilis.*)—Sometimes called swan or swamp potato. The Chippewa name for it is wab-es-i-pinig. It grows in muddy margins of northwestern lakes and rivers, and its tuberous roots furnish an important article of food. Aquatic birds are fond of them, and resort to favorite spots in spring to feast upon them, when the Indians slay the birds for their own feasts. The tubers are generally as large as hens' eggs, and are greatly relished when raw, but have a bitter milky juice not agreeable to civilized man. This is destroyed in boiling, however, and the roots are rendered sweet and palatable. They are considered excellent when cooked with meat, either salt or fresh. To collect the roots the Indians wade into the water and loosen them with their feet, when they float up and are gathered. They are of an oblong shape, in color whitish-yellow, banded with four black rings. The plant is also common in the Atlantic States.

Kamass root, or *wild hyacinth*, (*Camassia esculenta*, Fig. 1, Plate 1.)—This root resembles an onion in shape and a hickory-nut in size. It bears a pretty blue flower, and grows on rocky hills. The root is dug in June and July. When eaten raw the taste is pleasant and mucilaginous; when boiled it somewhat resembles that of the common potato. The Indian mode of preparing it for future use is to dig a pit, line it with rocks, upon which a fire is made, and, when heated sufficiently, the heated stones are swept clean and the roots are heaped upon them; grass or twigs are next laid over the pile, and, finally, a covering of earth. After several days the pit is uncovered, when the white roots are found to be converted into a thoroughly cooked, dark-brown, homoge-

PLATE XX.

[PLATE 2 INDIAN FOODS.]

NATIVE POTATO (*Solanum Fendleri*).

neous mass, of about the consistency of softened glue, and as sweet as molasses. Cooked in this manner, the roots are often made into large cakes, by mashing and pressing them together, and, when slightly dried in the sun, they become rather pliable and tough, and look like plugs of black navy tobacco. Its color does not recommend it to the taste, but it is sweet, mucilaginous, and as agreeable as the fresh root, excepting a slight smoky flavor acquired in baking. In this pressed form it keeps softer than in the raw state or when simply cooked, and may be kept for a year or more. The roots, when boiled in water, yield a very good molasses, which is much prized, and is used on important festival occasions by various tribes. The Indians of Cape Flattery, the Nez Perces of Idaho, and those of Pitt River, California, are the greatest consumers of this article of diet, under the name of kamass root.

Scorzonella ptilophora.—The root of this plant is small, succulent, and almost transparent, full of a bitterish, milky juice, and is eaten raw by the Nez Perces Indians.

Potato, (*Solanum Fendleri*, Plate 2).—Supposed to be the original of the cultivated potato. The writer found this plant growing in great abundance in that portion of northern New Mexico lying between Fort Wingate and Fort Defiance. The Navajo Indians inhabit this section, and this native potato forms one of their chief articles of diet in winter. The women dig the roots with whatever implements they can get, often using a strong, smooth piece of wood with a wedge-shaped end. The plant grows on low, rich spots, and by spring the earth is torn up in every conceivable direction in the search for potatoes. The tubers are quite small, one half to three-quarters of an inch in diameter, of good taste, and somewhat like a boiled chestnut. The Navajo Indians consume so large quantities at one time as to cause griping pains, and as a remedy take at the same meal a quantity of earthy matter containing magnesia, which relieves the stomach.

In 1869 a quantity of the bulbs was received by the Department of Agriculture, from New Mexico, and distributed to various parts of the continent. A few, planted in this vicinity, have largely increased in size.

Wild valerian, (*Valeriana edulis*,) called kooyah or tobacco-root by the Indians of the Northwest, and *raceme de tabac* by the French trappers. The root of this plant is remarkable for a very unpleasant taste and odor, which resemble those of chewing-tobacco. When first taken from the ground the root is very repulsive, and it must have been under the compulsion of severe hunger that the Indians discovered its edible qualities. In its fresh state it has poisonous properties, which are destroyed by baking the root in the ground for two days, when it is transformed into a nutritious and palatable article of food. The stench of this root is much more offensive when fresh, especially if made into bread or cooked in soup. The Indians of the North and Northwest are fond of it.

DRIED FRUITS AND NUTS.

Acorns.—*Quercus agrifolia*, *Q. Emoryi*, *Q. oblongifolia*, *Q. lobata*, and *Q. Hindsii*, are the principal large oaks which afford food for Indians, who eat their acorns raw, or roasted like pop-corn. When bread is to be made of them the acorns are ground raw or parched to suit the taste, and the flour is mixed with water and dried in the sun or baked in ashes. The bread tastes and looks like coarse black clay which has been sun-dried. Some tribes gather great quantities of acorns for winter use, especially the Diggers, who store them in round wicker baskets, holding

about ten bushels, which are covered with grass and earth to keep out moisture. The Apaches and Mexicans gather and consume the fruit of the dwarf oak, which grows abundantly in many parts of New Mexico and Arizona, this fruit being smaller and not so bitter as the former. Some of the species are quite sweet, and in seasons of plenty the Indians gather large quantities and sell them to the people along the Mexican frontier, and they are often to be found for sale in the stores of Arizona and New Mexico under the name of bayotis.

Mesquite, (*Algarobia glandulosa*. Plate 3.)—Frequently called mosqueit. The bean-like production of this common tree of the deserts is an important article of food with the Indians living within its reach. The pods are seven to nine inches long, of a buff color, ripen in June sufficiently for summer use, and travelers, both Indians and whites, chew them as they journey on. They are not only nutritious, but a preventive of thirst, having an agreeable blending of acidity and sweetness, somewhat like the early harvest apple. The pods, when in their fresh ripe state, are put into a wooden or stone mortar and bruised, then emptied into an earthen dish, mixed with water and allowed to stand a few hours, the result being a kind of cold porridge or mush. All present then collect around the newly-prepared mess, seating themselves on the ground near the dish, and, pressing the fingers of the right hand tightly together, at the same time bending the hand so as to form a scoop, dip in without ceremony, and without distinction of rank, age, or sex, forming a grotesque sight rarely to be witnessed outside of an Indian camp. The nearly naked bodies of the Indians soon become smeared from head to foot, and the shaggy appearance of their hair does not exhibit a lively sense of cleanliness. Each face wears a complaisant look, while their tumid abdomens afford certain proof of the quantity consumed. As the fruit or bean-like pods ripen they are gathered for winter use, being thoroughly dried and stored in cylindrical-shaped baskets, made of twigs and covered with grass and earth to keep out rain, in which shape they may be preserved a long time. They form a sweet, nutritious food, and are among the great luxuries of the Apaches, Pimas, Maricopas, Yumas, Yavapais, Mohaves, Hualipais, Cocopahs, and Moquis of Arizona, besides many tribes in New Mexico, Utah, Nevada, and the southern portion of California. The Indian women pound the dry pods until reduced to a fine powder, which being mixed with a little water, is pressed into large thick cakes of several pounds' weight, and dried in the sun, to be used as circumstances require. They are often kept in the pulverized state in bags, or stored as pods, but if not thoroughly pulverized so that the seeds are as fine as the pulp they will soon become a living mass, since from every seed will come forth an insect, a species of *Bruchus*. This, however, makes little difference to the Indians, who do not pick the insects out, but let them become an ingredient of the bread. If reduced to fine flour the larva of the insect becomes a part, forming a homogeneous mass of animal and vegetable substance. The flour, being very sweet, when mixed with water forms an agreeable drink, and when made into gruel is very palatable. If boiled in water and fermented, a pleasant and nutritious drink, much esteemed by the Indians, is the result. When the crop of mesquite beans fails there is great suffering among the tribes. Excellent vinegar can be made from the pods, and horses and cattle soon grow fat by eating them. The gum which oozes out of this tree, when perforated by insects, is often eaten. All the Indians of Arizona mix this exudation with mud, which is then daubed over the entire head, serving two purposes—killing all the insects, and rendering the hair very black and glossy. It is in fact a very good hair-dye. The women use the bark

PLATE XXI.

[PLATE 3 INDIAN FOODS.]

MESQUITE (*Algarobia glandulosa*).

of this tree to make skirts, and twist it into rope or twine, and even weave it into baskets.

Western juniper, (*Juniperus occidentalis.*)—The fruit of this tree is a large and tuberculated berry, sweet and nutritious, especially when it is first ripe; nevertheless it has a resinous taste peculiar to the juniper. It is largely consumed by all the Indians of Arizona and New Mexico, who gather great quantities for winter store. When dried and ground into flour, mixed with water, kneaded into a hard mass, and dried in the sun, it has a chaffy look of a brownish yellow color, is very light, easily digested, and not offensive, as its juniper taste is not objectionable to the Indians. The bread, having a chaffy or sawdust consistency, would not be palatable to the white man. Mexicans consume this fruit in large quantities, and it constitutes an article of trade among them. An analysis of the bread shows: Water, 14.34; proteine compounds, 5.69; starch, 17.87; sugar, 10.66; cellulose, gum, oil, &c., (by difference,) 47.58; ash, 3.86=100.

NUTS.

Hickory nuts, (*Carya alba;*) *Pecan nuts*, (*Carya olivæformis;*) *Hazel nuts*, (*Corylus Americana;*) *Walnuts*, (*Juglans nigra.*)—These nuts grow abundantly in most of the States east of the Missouri River, in the Indian Territory, and in Arkansas. In former years they furnished the food for a much larger number of Indians than at present, the greater portion of the tribes having been removed farther west. The quantity consumed at one time seems incredible, and would certainly be unsafe for more civilized stomachs.

Iron-wood, (*Olneya tesota.*)—This tree grows in the most desolate and rocky places of Arizona and Sonora. The seeds are produced in bean-like pods of a shiny mahogany color, in size and shape somewhat like a pea, and are eaten raw and roasted by the Indians. When care is taken to parch them they equal peanuts, with no perceptible difference in taste. The Mohave Indians, of Arizona, store them for winter use.

Pine nuts, (*Pinus Sabiniana*, *P. monophylla*, *P. Parryana*, *P. Lambertiana flexilis*, *P. Coulteri.*)—These trees grow in the mountains of the western Territories, and the seeds are commonly called pine nuts, and are used as an article of food by all the Indians inhabiting the regions in which they grow. The seeds are oily, of a very disagreeable flavor, but highly nutritious. The woodpeckers collect them for winter use, and the Digger Indians hunt for the hidden stores and pilfer them with much delight. The Indians of California, Nevada, and Utah consider these nuts one of their main articles of subsistence.

Edible pine, (*Pinus edulis.*)—This small scrubby pine grows on the dry rocky mountains of New Mexico, and is called by the Mexicans piñon. The seed is about the size of a kidney bean, with a rich oily kernel in a thin shell. It has a pleasant flavor, and sometimes oil is expressed from it. In favorable seasons the seeds are gathered in quantities and sold by the Indians to the people of New Mexico, Arizona, and the border settlements of Mexico. The price is 50 cents to $1 per pound. They should be roasted before eaten, though sometimes they are consumed raw.

The Indians of Alaska in the spring are in the habit of stripping off the outer bark of *Pinus contorta* and scraping the newly formed cambium from the trunk. This is eaten fresh or dried, pressed into compact cakes of a dark claret brown. It has a coarse look, as if made of tanner's bark, and if broken up it presents a checkered appearance. When fresh it is not unpleasant, and the effect is that of a gentle lax-

ative, but as the season advances it becomes strong in turpentine. When the cakes are old they have a bitter taste not unlike that of pine chips.

Sugar maple, (*Acer saccharinum.*)—In the spring the Indian families throughout the Northern States repair to their respective sugar camps. The sap collected from the trees is carried in bark buckets and boiled down in the usual way. Sugar-making forms a sort of Indian carnival, and boiling candy and pouring it out on the snow to cool is the pastime of the children. The women make the sugar, which is put up for sale in boxes made of white birch bark and called mococks. The boxes designed for sale are of all sizes, weighing from twenty pounds to seventy, and are generally exchanged for merchandise. Winnebagoes and Chippewas are the largest manufacturers, the former often selling to the Northwest Fur Company fifteen thousand pounds a year.

Soap berry, (*Sapindus marginatus.*) So called from yielding a soapy substance when soaked in water. It produces its berries in large clusters the size of cherries, containing a clear, creamy, yellow, glue-like substance surrounding large, hard, black seeds. The Alaska Indians pound these berries and press the pulpy mass into round cakes weighing two or three pounds. These look like anything but bread, being a black, forbidding mass, with the shining black seeds, but partially broken, studding the outside. The taste of this is much worse than that of the meanest tobacco, having a smoky flavor added. The latter is acquired by the suspension of the cake over the fires in the tents to dry, which also gives it a black color. It is the most repulsive of all Indian articles of food. The white albumen in the interior of the seeds contains the nutritive substance. An analysis of the soap-berry bread gives the following result: Water, 18.16; proteine compound, 14.44; starch, 12.10; sugar, 14.71; cellulose, gum, oil, &c., (by difference,) 36.98; ash, 3.61 =100.

Screw bean, (*Strombocarpus pubescens*, Plate 4.)—A translation of the Spanish word *tornillo*, being twisted like a screw. It does not ripen until late in the fall, nor is it fit to use until ripe and quite dry, being insipid; but no sooner is it ripe and divested of moisture than it becomes excessively sweet and very palatable, and is considered a superb article of diet by the Indians along the Colorado River of Arizona, and by the Utahs, who collect with assiduity all they can and store for winter use. It will keep a long time, but is subject to the attacks of a species of *Bruchus*, a small insect which is buried in the fruit, and consequently, when pulverized and made into bread, is eaten with the rest. If the beans are left in the storehouse unpounded, the insects will escape, but, as sometimes happens, when it is wished to reduce the supply of beans to a smaller compass, they are somewhat coarsely pounded up. The seeds, however, being hard, are generally kept whole. This coarse meal undergoes a peculiar change, like fermentation, and after being put under pressure for a short time acquires the taste desired by the Indians. When bread is to be made from the beans or the pulverized meal, the whole mass, as in the case of mesquite, is finely ground in a mortar, mixed with water, kneaded hard, and baked in the sun. It is then fit to use and will keep some time; is sweet and more nutritious than the mesquite bread. The flour makes an excellent gruel, or if mixed with water is not to be refused as a beverage by either red or white man. By boiling the coarse meal in water a good molasses is obtained, and a pleasant and stimulating wine may be made from this fruit. All kinds of animals are fond of it and fatten upon it. It might form an excellent hedge plant for many parts of the United States.

Giant arbor-vitæ, (*Thuja gigantea.*)—The Indians scattered along the

PLATE XXII.

[PLATE 4 INDIAN FOODS.]

SCREW BEAN (*Strombocarpa pubescens*).

Columbia River, in Oregon, collect the cambium from this species of cypress in the same manner as the Alaska Indians do that from *Pinus contorta*, and preserve and use it in the same manner.

BERRIES.

Manzanita, (*Arctostaphylos tomentosa.*)—The manzañita of the Spaniards. It is a dwarf evergreen, producing a small fruit similar to the well-known bearberry, of an astringent taste. It also possesses acid properties, and by the early Spanish settlers of California, Arizona, and New Mexico was called manzañita, or little apple, as, when not fully ripe, it tastes like an agreeably tart apple. When bruised and mixed with water it forms a cooling drink for summer. The fruit is extensively eaten in a fresh or dried state by both Indians and wild beasts. When dry it is husky, though sweet to the taste, and is often ground, made into bread and baked in the sun. The meal from these berries is often mixed with other substances, as corn meal, pounded berries, sirup of *Cereus giganteus*, &c., to cause fermentation, forming various drinks used by the Indians.

Menzies's arbutus, (*Arbutus Menziesii.*)—A fine, showy evergreen shrub, with red berries, in clusters, eaten by birds and Indians of California.

Bearberry, (*Arctostaphylos uva-ursi.*)—This plant is the killikinick of the Indians and larb of hunters. It is a small plant growing among rocks in the western mountains; has a deep red berry somewhat larger than the common currant; has a sweet spicy taste, and is very pleasant food.

Shadberry, (*Amelanchier Canadensis.*)—This shrub grows in the mountains of California, Oregon, Utah, and Alaska; and the berries are eaten, both fresh and dried for winter use, by all the Indians. They are used by white settlers also, who call them shadberries. They are good when fresh, and when dry have an agreeable taste, are excellent for mixing with pemican, (preserved meat,) and when boiled in broth of fat meat are a dainty dish and used in all the Indian feasts. In preparing the fruit for future use a favorite plan is to take a tub holding twenty or thirty gallons, on the bottom of which bark of the spruce tree is placed; upon this bark a quantity of berries is laid; stones nearly red hot are next laid on; then another layer of berries, then hot stones, and so on until the tub is filled. The whole is then allowed to remain untouched for six hours, when the fruit will be thoroughly cooked. It is then taken out, crushed between the hands, and spread on splinters of wood, tied together for that purpose, over a slow fire, and while it is drying the juice which was pressed out in cooking in the tub is rubbed over the berries. After two or three days' drying they will keep a long time, and are very palatable, more so when a few huckleberries are mixed with them.

Barberry, (*Berberis aquifolium*,) sometimes called false Oregon grape. It has deep blue berries in clusters somewhat resembling the frost grape, and the flavor is strongly acid. It grows in the mountains of the Northwest. It is used as food, and when bruised and mixed with sugar and water forms a pleasant drink.

Hawthorn, (*Crataegus coccinea.*)—The fruit of this plant is eaten fresh and mixed with choke cherries and service berries, which are bruised, then pressed into cakes, and dried for winter use.

Crowberry, (*Empetrum nigrum.*)—This interesting species of heath-like plant produces a black berry which is consumed in its ripe state, also dried for winter. It grows on the alpine summits of the Northwest.

Wild strawberry, (*Fragaria Virginiana.*)—This fruit grows abundantly

in Kansas, Rocky Mountains, California, and Minnesota, and the Indians hold the fruit in as high estimation as more civilized persons.

Wintergreen, (*Gaultheria procumbens.*)—The spicy berries of this plant are eaten by the Indians of Michigan and Wisconsin.

Honeysuckle, (*Lonicera involucrata.*)—This plant grows in damp places in the Cascade Mountains. The Indians residing there eat the fruit, which is sometimes called bearberry. It is also eaten by the Indians of Alaska.

Honeysuckle, or *Twinberry*, (*Lonicera ciliata*,) grows abundantly in the mountains of Oregon and Alaska, is considered good to eat by the hunter, and is much used by the aborigines.

One-flowered pipsissewa, (*Moneses uniflora.*) grows in Alaska. The fruit, often called moss berries, is used as food. The yield of the berries is scant, however.

Crab apple (*Pyrus coronaria*, Fig. 1, plate 5) grows in the Cascade Mountains and in Alaska. Specimens are in the Department of Agriculture, collected in latitude 54° 45′ north, longitude 130° 41′ west, presented by T. A. Henriques, of the United States revenue steamer Lincoln.

Wild cherry, (*Cerasus Virginiana.*)—Commonly called choke-cherries. This fruit is used both fresh and dry, and in the latter condition is often mixed with meat, pounded together, and dried for winter. The bark is made into tea, and drank by some of the Indians. It grows in Utah, Oregon, Arizona, and in the Rocky Mountains, and is much relished by all the aborigines. The fruit is sometimes pounded fine and dried in the sun, and in this condition is boiled in broth or with meal made from various roots or seeds.

Wild currant, (*Ribes.*)—In New Mexico it is called samita. The fruit is not very palatable, being offensive to some, but the Indians eat it. The berries are a bright amber color, and very tempting to the sight, somewhat resembling the gooseberry. In Colorado several settlers came near losing their lives by eating this berry.

Buckthorn, (*Rhamnus croceus.*)—This is a fine evergreen, producing numerous red berries which render it very showy. The Apaches collect and pound them up with whatever animal substances may be on hand, the berries imparting to the mixture a bright red color, which is absorbed into the circulation and tinges the skin. On one occasion a detachment of the First Arizona Infantry attacked a camp of Apaches in the Mogollon Mountains, Northern Arizona, killed twenty-two and captured two children. The writer, being with the party as surgeon, examined the dead. Their abdomens were much distended from eating greedily of these berries and other coarse substances. Their bodies exhibited a beautiful red net-work, the coloring matter having been taken up by the blood and diffused through the smallest veins.

Raspberry, (*Rubus strigosus.*)—This fruit, known to whites and Indians, grows in Texas, Arizona, Colorado, Oregon, Alaska, and other sections, and is a universal favorite.

Missouri currant, (*Ribes aureum.*)—Black and yellow varieties of the wild currant are much used by the Indians of Colorado, Utah, Arizona, Texas, Oregon, California, and Alaska.

Gooseberry, (*Ribes hirtellum*, Fig. 2, Plate 5.)—It is abundant, and used by the Indians of Colorado, Oregon, Alaska, Arizona, and Utah.

Wild rose, (*Rosa cinnamomea.*)—The berries or seed capsules of this plant, when turned by frost, are very pleasant to eat, not being woolly, as the rose berries of the States, but sweet and juicy, and serve as an excellent antiscorbutic for the Indians of Alaska.

PLATE XXIII.

[PLATE 5 INDIAN FOODS.]

Fig. I

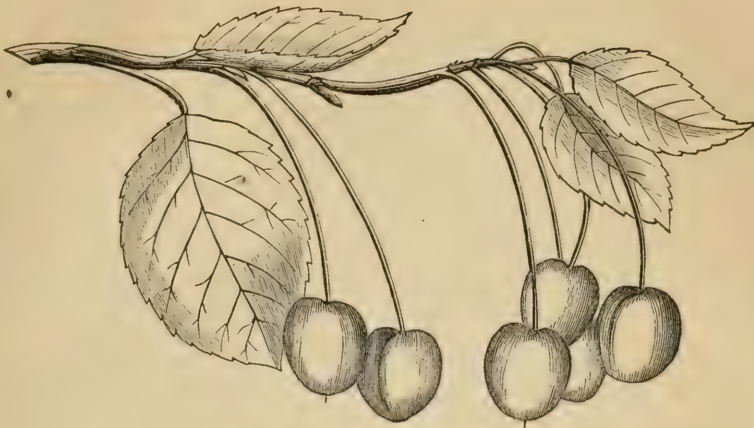


Fig. 2

Fig. 1. Crab apple (*Pyrus coronaria*).
Fig. 2. Gooseberry (*Ribes hirtellum*).

Ash-leafed rose, (*Rosa fraxinifolia.*)—This plant grows in the Cascade Mountains, where the Indians eat its fruit.

Salmon berry, (*Rubus spectabilis.*)—This is used largely by the Indians along the northwest coast. In the spring the young sprouts of the salmon berry and thimble berry, (*Rubus Nutkanus*,) are consumed in great quantities. They are very tender, have a slightly acid and astringent taste, and appear to serve as an alterative to the system, which has become loaded with humors from the winter's diet of dried fish and oil. The sprouts are sometimes cooked by being tied in bundles and steamed over hot stones, and are highly relished. The fruit is an excellent antiscorbutic.

Common blackberry, (*Rubus villosus.*)—Found in Northern Missouri, Texas, California, and Minnesota. The Indians keep in remembrance the localities where this plant grows, and are as fond of its fruit as are the whites.

Thimble berry, (*Rubus Nutkanus.*)—Grows throughout the Northwest, and is a great favorite with the Indians. It acts as a fine antiscorbutic.

Dewberry, (*Rubus Canadensis.*)—Grows abundantly in Southern Kansas, having a fine rich flavor, and is held as a great delicacy by Indians and whites.

Buffalo berry, (*Shepherdia argentea.*)—This is a shrub fifteen feet high. The berries are about the size of peas, of a bright scarlet color, containing but one seed. They are pleasantly acid, and the Indians are extravagantly fond of them. Utah, Nebraska, and Oregon produce the plant in abundance.

Snowberry, (*Symphoricarpus racemosus.*)—Grows in the mountains of Oregon and Washington Territory, and is eaten by the Indians.

Cranberry, (*Vaccinium macrocarpon.*)—Grows in lakes and swamps, sometimes under water. The Indians gather the fruit from September to the time of snow-fall. To them it is an important fruit as food, and as an article of commerce with the tribes of the Northwest.

Blueberry (*Vaccinium Pennsylvanicum.*)—Grows abundantly along the northwest coast. The Indians are very fond of this, to them, very desirable fruit. They collect large quantities, and smoke-dry them for winter use.

Huckleberry, (*Vaccinium myrtillus.*)—This favorite fruit of the Indians grows in the Rocky Mountains.

Squaw huckleberry, (*Vaccinium stamineum.*)—This is an agreeable fruit, growing in Wisconsin and Michigan, of which the Indians make extensive use.

Wild grape, (*Vitis Californica.*)—It grows in Texas, the Indian Territory, Arkansas, Kansas, Nebraska, Colorado, and Arizona. The quantity of this fruit that an Indian will consume at one time is scarcely credible. The ancient Pueblo Indians were in the habit of cultivating it, as is evident from the peculiar distribution of the plants near ruined settlements. In Arizona, near Fort Whipple, they are arranged in rows and are very old. At Camp Lincoln, on the Verde River, near which were a number of ancient Indian ruins, a small stream called Clear Creek passed close by, on each side of which was a narrow strip of rich land, covered with under-brush, among which were found several grape vines, planted at short intervals, that differed in many particulars from those native to the locality.* The small kinds, found so universally in the woods, were growing abundantly all around, but on no other spot could the cultivated kinds found on Clear Creek be discovered. The latter were near dilapidated habitations, the owners of which were evi-

dently domestic in their habits. The vines were quite old, and had been repeatedly burnt off, as the stumps testified. The fruit was superior in flavor to the common wild grapes, being sweet and slightly acid. Some were foxy in their nature, while others resembled the Isabella; and one was much like the shriveled Frontignac in taste, size, and habit of plant. Some were short growers, while others ran, like the frost-grape. Specimens of each were dried and sent to Dr. George Englemann, of St. Louis, who had the seeds planted. There seemed to be five or six varieties. Dr. Englemann is of opinion that they are one species distinct from the eastern plant, closely allied to *Vitis Californica*, if not a mere variety of it. He has provisionally named it *Vitis Arizonensis*.

FLESHY FRUITS.

Giant cactus, (*Cereus giganteus.*)—This noted plant of the barren hills of Arizona is commonly called monumental or giant cactus. It grows twenty-five to fifty feet high, and four and a half in diameter, is deeply ribbed, and covered with long black spines. Its fruit (Fig. 1, Plate 6,) is pear-shaped, of a greenish-yellow color, with a few small spines scattered over the surface, which fall off as the fruit becomes thoroughly ripe. The fruit is borne upon the highest part of the plant, and is usually gathered by means of long, hooked sticks. The interior of the fruit is of a beautiful red color, and looks tempting; the rind is pulpy, fibrous, juicy, and sweet; the pulp is very palatable, and is full of small black seeds, which are also eaten, reminding one of figs, the only difference being that it has more moisture. The seeds are indigestible, unless well chewed. The Indians of Arizona, Sonora, and the southern portion of California consider this one of their greatest luxuries, and as long as the fruit is obtainable care for nothing else. To dry this fruit as a preserve, the seedy pulp is placed between soft inner corn-husks, the ends of which are tied, and it is then dried in the sun, for winter use or trade. It is also put into earthen pots when fresh, secured from the air, and sold in the settlements. It retains its sweetness for a long time, as is shown by a sample in the museum of this Department, deposited three years since. In one instance it has undergone a slight fermentation, and its color has changed to a Vandyke red. A clear, light-brown sirup is expressed from the pulp, and sold in one-gallon jugs, (also made by the Indians,) for $2 to $5. The Papajo Indians are the largest producers of this sirup. The Pimo Indians, of the Gila River, annually prepare a wine from this fruit, called by the Mexicans tiswein, by taking the fresh pulp or the sirup and mixing with it a certain quantity of water in earthen vessels, and exposing it to the sun for some time to ferment, after which it is fit for drinking. It is highly intoxicating, with the taste and smell of sour beer; but some time elapses after drinking before its stimulating effects are felt. When the wine is ready for use, the Indians celebrate an annual drinking festival. These gatherings are anxiously anticipated for months, and expeditions which have been planned against the Apaches, while under the influence of drink, are then carried into execution. A sample, three years old, in the Smithsonian Institution, has improved by age, having acquired a slight sour muscat taste, but is still very disagreeable. It is of a clear, amber color, and in every respect superior to much of the wine on sale.

Thurber's cactus, (*Cereus Thurberi.*)—This is commonly called pitahaya by the Mexicans. It grows in the Papajo Indian country, on the borders of Arizona and Sonora, eighteen to twenty feet high, and four to

PLATE XXIV.

[Plate 6 Indian Foods.]

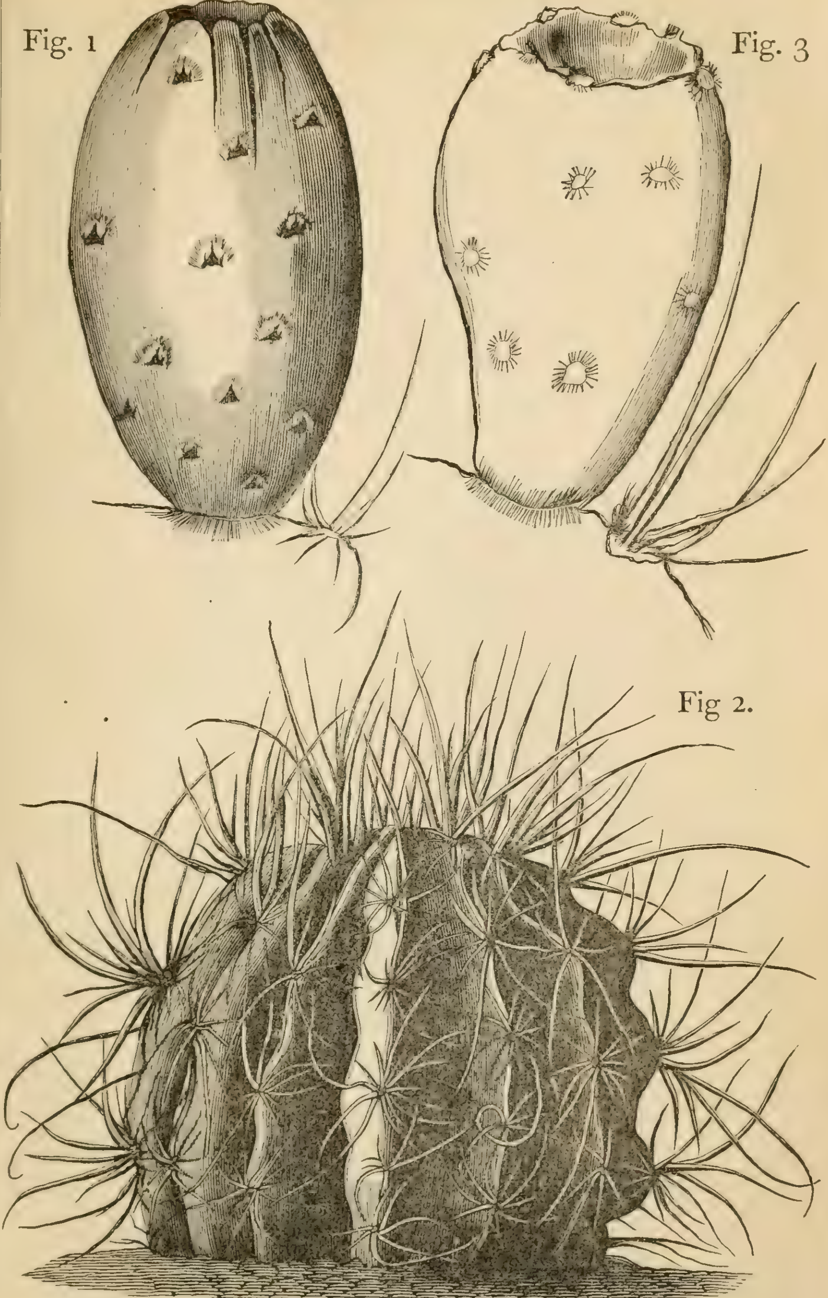


Fig. 1. Giant cactus (*Cereus giganteus*).
Fig. 2. *Echinocactus Wislizeni.*
Fig. 3. Prickly pear.

six inches in diameter, and bears two crops of fruit per year. The fruit is the size and shape of an egg, and is thickly covered with long, black spines. As it ripens it becomes tinged with red, the spines fall off, the fruit splits open, and exposes a rich red, juicy pulp, with small black seeds. This is a decidedly better fruit than that of the *Cereus giganteus*, but it is used in every respect for the same domestic purposes. The Papajo Indians, in transporting earthen vessels filled with sirup or preserves made of this fruit to market, cover their jars with a thick coating of mud, which renders them less liable to break in handling, and at the same time keeps the contents cool, and prevents evaporation, the crockery used being very porous. The fruit is eaten in enormous quantities, and, being very nutritious, the consumers quickly acquire an extraordinary increase of bulk. In making wine or sirup the seeds are easily separated from the pulp by the use of water. They are carefully collected, dried, parched, and pulverized, after which process they are digestible and nutritious.

The persimmon, (*Diospyros Virginiana.*)—This fruit grows abundantly in the Indian Territory and in Arkansas. The Indians consume large quantities of it when ripe. It is prepared for future use after the manner of making apple-butter.

Echinocactus Wislizeni, (Fig. 2, Plate 6.)—This singular species of cactus is commonly called by the Spaniards biznacha, and being twenty inches or more in diameter, a section of the stem is often employed as a cooking vessel. The seeds are small and black, but when parched and pulverized, make good gruel and even bread. The pulp of the fruit is rather sour, and not much eaten. Travelers in passing through the cactus wastes often resort to this plant to quench their thirst, its interior containing a soft white watery substance, of slightly acid taste, which is rather pleasant when chewed. It is a common sight to see on each side of the road these plants with a large perforation made by the thirsty traveler. An Indian, when traveling and wishing to make a meal, selects a large plant, three feet or more long and two in diameter, cuts it down and hollows it out so as to form a trough; into this he throws the soft portions of the pulpy substance which surrounds the central woody axis, and adds meat, roots, seeds, meal, fruits, or any edible thing on hand; water is added, and the whole mixed together; stones are then highly heated and dropped into the mixture, and, as they cool, are taken out, licked clean, reheated, and returned to the cooking vessel, until the mixture is thoroughly boiled. This is a favorite dish with the Yabapais and Apaches of Arizona. The Papajo Indians pare off the rind and thorns of large plants of this species of cactus, letting it remain several days to bleed, when the pulp is pared down to the woody axis, cut up into suitable pieces, and boiled in sirup of the *Cereus giganteus* or *Cereus Thurberi*. If a kind of sugar which is made by the Mexicans is attainable, it is employed instead of the sirup, thus forming a good preserve. These pieces, when taken out of the liquid and dried, are as good as candied citron, which they much resemble in taste and substance.

Mulberry, (*Morus rubra.*)—This tree grows abundantly in Northern Missouri and along the rivers of Kansas, the fruit being large, sweet, and of a black color. The Indians will travel many miles in search of it. It is found also in the Indian Territory.

Prickly pear, (*Opuntia Engelmanni*, *O. vulgaris*. *O. Camanchica*, *O. Rafinesquii*, *O. occidentalis*, Fig. 3, Plate 6.)—The fruit of these species of cactus is much eaten by all the Indians of New Mexico, Arizona, California, and Utah, under the common Spanish name of *tunas*,

great quantities being dried for use in the winter. These plants grow in arid desert localities which produce nothing better; they are large and of a bright red to purple color; of a rather pleasant, sweet, somewhat acid taste, and have thin skins and rather large seeds, which are discarded. The skin is studded with bunches of very fine downy spines, which the Indians brush off with a bunch of grass. The Apaches use wooden tongs to gather the fruit, to prevent being scratched by these spines or the thorns of the plant. The Pawnees and Papajoes dry the unripe fruit of the *Opuntia* for future use, to be cooked with meat and other substances. The fresh unripe fruit is often boiled in water from ten to twelve hours, until soft, when it becomes like apple-sauce; then, being allowed to ferment a little, it becomes stimulating and nutritious. Some Indians roast the leaves of the *Opuntia* in hot ashes, and, when cooked, the outer skin, with the thorns, is easily removed, leaving a slimy, sweet, succulent substance, which is eaten. Hunger and destitution frequently compel Indians and white men to live for many days on this food. A yellowish white gum often oozes out of the leaves of the *Opuntia*, which is also eaten.

Indian pear, (*Pyrus rivularis.*)—The fruit of this tree has a very pleasant flavor, and is largely consumed by the Indians of Alaska.

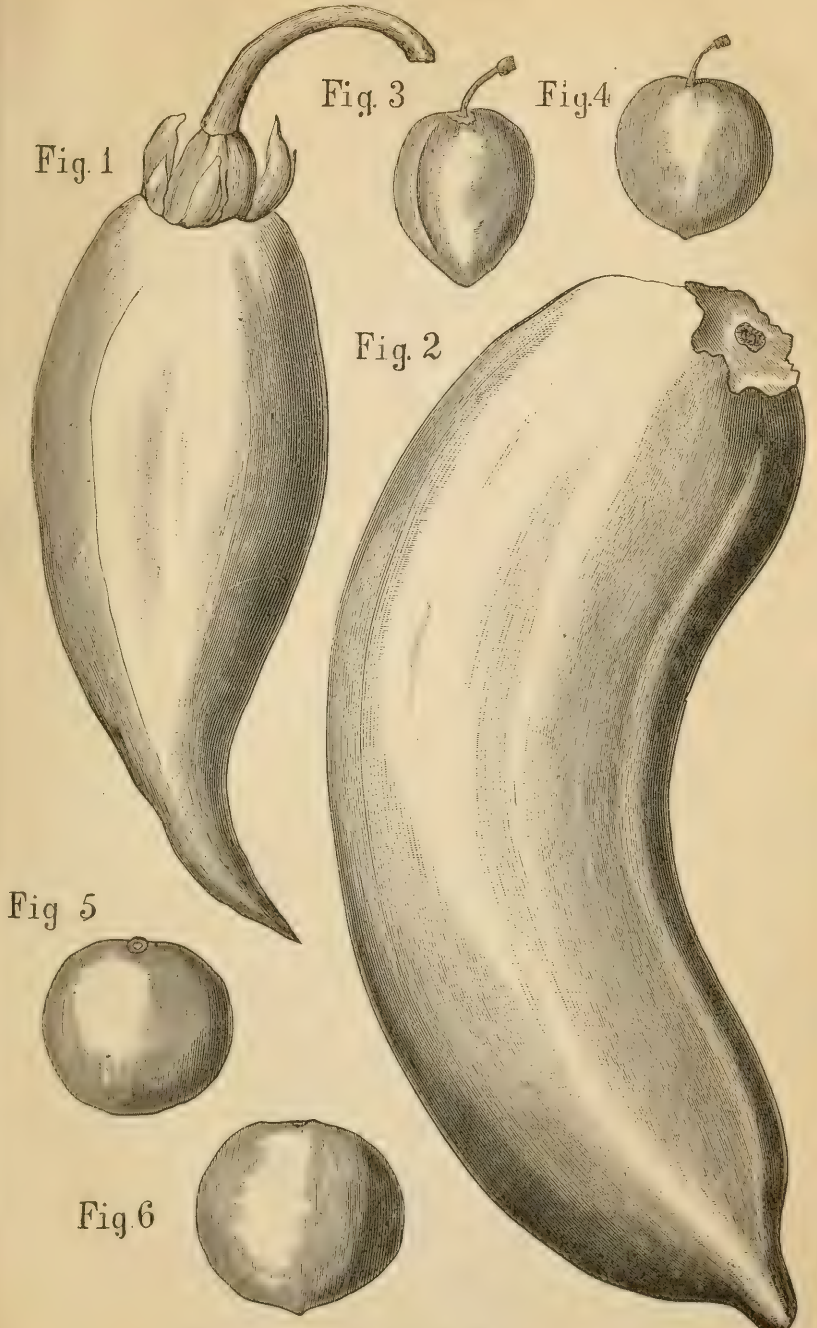
Prunus Americana is found in Colorado, Kansas, Utah, Oregon, and Texas. During the ripening of the fruit the Indians live sumptuously, and collect quantities for drying.

Dwarf cherry, (*Prunus pumila*, Figs. 3, 4, 5, 6, Plate 7.)—This interesting species of the plum is but a small bush two to six feet high. The fruit is larger than a damson, sweet, and in color varies from a light pink to a deep crimson, and from a light to deep yellow, and grows abundantly in the Indian Territory. Every Indian, young and old, capable of traveling, goes to the plum ground in the proper season, as it is their great harvest. The fruit is dried, and also made into preserves. The plant thrives in sandy wastes, and is sometimes called sand-hill plum.

Spanish bayonet, (*Yucca baccata*, Figs. 1 and 2, Plate 7.)—The fruit of this spinous-leafed plant is commonly called banana. It is produced upon a stem a little longer than the leaves, with several laterals. The number of the fruit that matures on a plant varies from one to six. When ripe they are the size and somewhat the shape of the West Indian banana, from their resemblance to which the common name of the plant is derived. The fruit is of a greenish yellow color, of a soft, pulpy nature, very sweet and palatable, with large black seeds. It is produced every other year. The Indians of Arizona, New Mexico, and Utah are very fond of it, and they dry great quantities for winter use. On one occasion the troops in Northern Arizona captured a quantity of the dried fruit from the Apaches, and, being sweet, it was generally eaten; and for some time neither salts nor castor-oil were needed from the medicine-chest, as this fruit proved to be a vigorous cathartic when dry. The unripe fruit is roasted in hot ashes and then eaten. The young flower-buds when about to expand are also roasted, being a highly-prized article of diet. To a white man it is an insipid substance. The leaves of this species of *Yucca* produce a long and strong fiber, somewhat coarse, but very durable. The Indians of New Mexico and Arizona prepare the fiber either by first drying the leaves, and then beating off the dry pulp, or by macerating them in water, which rots off the pulpy matter. The plant will grow on the poorest kind of dry soil, and its introduction into such portions of the Southern States as are suited to its growth would seem to be desirable.

PLATE XXV.

[PLATE 7 INDIAN FOODS.]



Figs. 1 and 2. Spanish bayonet (*Yucca baccata*).
Figs. 3, 4, 5, and 6. Dwarf cherry (*Prunus pumila*).

SEEDS.

Milk vetch, (*Astragalus.*)—A genus of leguminous plants, several species of which are used as food by the Indians of the Western Territories, and are commonly called Indian pea, pop-pea, ground plum, or rattle-box weed. The pods adhere to the wool of sheep, and become objectionable to the farmer. The pea divested of the hull is boiled for food.

Lamb's quarter, (*Chenopodium album.*)—The young tender plants are collected by the Navajoes, the Pueblo Indians of New Mexico, all the tribes of Arizona, the Diggers of California, and the Utahs, and boiled as herbs alone, or with other food. Large quantities also are eaten in the raw state. The seeds of this plant are gathered by many tribes, ground into flour after drying, and made into bread or mush. They are very small, of a gray color, and not unpleasant when eaten raw. The peculiar color of the flour imparts to the bread a very dirty look, and when baked in ashes it is not improved in appearance. It resembles buckwheat in color and taste, and is regarded as equally nutritious. The plant abounds in the Navajo country.

Ericoma cuspidata.—This is a singular species of grass, which is found growing wild in moist, sandy spots in Nevada, Arizona, and New Mexico, and produces a small, black, nutritious seed, which is ground into flour and made into bread. It is held in high estimation by the Zuni Indians of New Mexico, who, when their farm crops fail, become wandering hunters after the seeds of this grass, which is abundant in their country. Parties are sometimes seen ten miles from their villages, on foot, carrying enormous loads for winter provision.

Panic grass, (*Panicum.*)—It grows on the bars and moist sides of the Colorado River, in Arizona. After the June rise in the river has subsided, the plant rapidly perfects its seeds, which the Indians collect with much care, cleaning them by means of the wind, and store them for winter use. After the seeds are ground into flour, water is added, and the mass is kneaded into hard cakes, which, when dried in the sun, are ready for use. Gruel and mush are likewise made of the flour. Sometimes the Indians plant this grass near their homes, to avoid the trouble of hunting it. When the water has laid bare the river banks during the month of June, they scatter the seeds over the ground by blowing them from their mouths, and a crop is the result, which for them is equal to wheat.

Wild oat, (*Avena fatua.*)—Indigenous oats of California. This plant covers hundreds of thousands of acres of hill and plain, from Upper Sacramento to San Diego, and the mountain sides east and west, as also the San Joaquin plains and mountains of California. The Indians gather this grain and use it as wheat or any other seed. Some of the early travelers call this plant pin grass.

Sunflower, (*Helianthus.*)—From one or several species of the dwarf sunflower of the West, which grows on river bottoms and rich, moist spots on the prairies, the seeds are often gathered. Being very sweet and oily, they are eaten raw, or pounded up with other substances, made into flat cakes and dried in the sun, in which form they appear to be very palatable to the Indians.

Bur clover, (*Medicago lupulina.*)—This common plant of Southern California produces abundance of seeds, which are much relished by the Indians and by cattle. It bears a small kidney-shaped pod, containing a single bean.

Indian corn, (*Zea mays.*)—If the ancient use of this plant as food by Indians needs verification, evidence is now accessible both from North

and South America. The Smithsonian Institution has an ear of corn (Fig. 3, Plate 8) found deposited in an earthern vessel eleven feet under ground, in a grave with a mummy, near Ariquipe, in Peru. The grains are rather sharp-pointed, small, and slightly indented at the apex, lapping one over the other, in thirteen rows. A small portion of this specimen is broken off, hence it is but four and a half inches long. When stationed at Camp Lincoln, Arizona, as post surgeon, the writer explored some ancient rock caves near by, which were plastered in the interior, and obtained several corn-cobs, two of which were preserved, and are now in the museum of the Smithsonian Institution. One is slender and narrow, (Fig. 1, Plate 8,) being five and one-quarter inches long; the other is thicker, but its length is only four and one-half inches. The former had ten and the latter eight rows of grains, with no more difference discernible than exists among the corn raised by all the Pueblo Indians of to-day, and which certainly is the kind grown by them at the Spanish conquest of Mexico. The ruins in which the cobs were found have not been inhabited by the present Indians of the country, who are Apaches, as they believe that evil spirits hover about them, and therefore will not enter them. The past summer the writer opened a mound near St. George, Utah, in which several nicely made and well-burnt earthen pots were found, full of human ashes, charcoal, and several pieces of charred corn-cob. Corn may be said to be the most universal article of food cultivated by the Indians of New Mexico, Arizona, California, Nevada, and Utah, while the tribes of the Indian Territory consider this grain their staff of life. The cultivation of corn has not been acquired by them from others. It is a matter of historical record that, when living in the Southern States, long before the white man set foot in the country, it was cultivated, and by nearly all the Indians of the present United States to a greater or less extent. The Indians who grow it in the primitive manner, and have the original corn of America, are the Pueblos of New Mexico and Arizona. The grains vary in color through shades of pink, blue, and white, and the ears are generally rather small and slender. The blue variety (Fig. 2, Plate 8) is preferred for bread, and is sorted from the rest with much care, and stored by itself. The ear has fourteen rows of grains, which are full and plump, and is six and three-quarters inches long, and four and three-quarters inches around. The corn, after being reduced to meal in a stone mortar, has a peculiar bluish-white appearance. In converting it into bread, it is mixed into a thin batter, a brisk fire is made to heat a slab of iron, or stone, or a flat earthenware plate, which is elevated from the ground by stones to admit the fire; when sufficiently heated, the women press the fingers of the right hand together, dip them in the batter, drawing them out thickly covered with the mixture, at the same time drawing the hand equally over the heated baker, leaving a thin coating, which quickly curls up, a sign that it is cooked on that side; it is then taken off, another dip is made with the fingers, and the baker is besmeared again; then the upper side of the first cake is laid on the top of the new dip; when the second one is ready to turn, the first one is already cooked, and the second is put through the same process as the first, and so on until a number of these large thin sheets of wafer-like bread is accumulated. They are rolled up together, and form what is called by the Moqui Indians guagave. It looks like blue wrapping-paper, but somewhat coarser, and has a polished appearance. During the summer of 1869, the writer and Mr. Vincent Collier, with Lieutenant W. Krause, visited the Moquis, and were feasted bountifully at every house with this blue paper-like bread. At first it seems dry in the

PLATE XXVI.

[PLATE 8 INDIAN FOODS.]

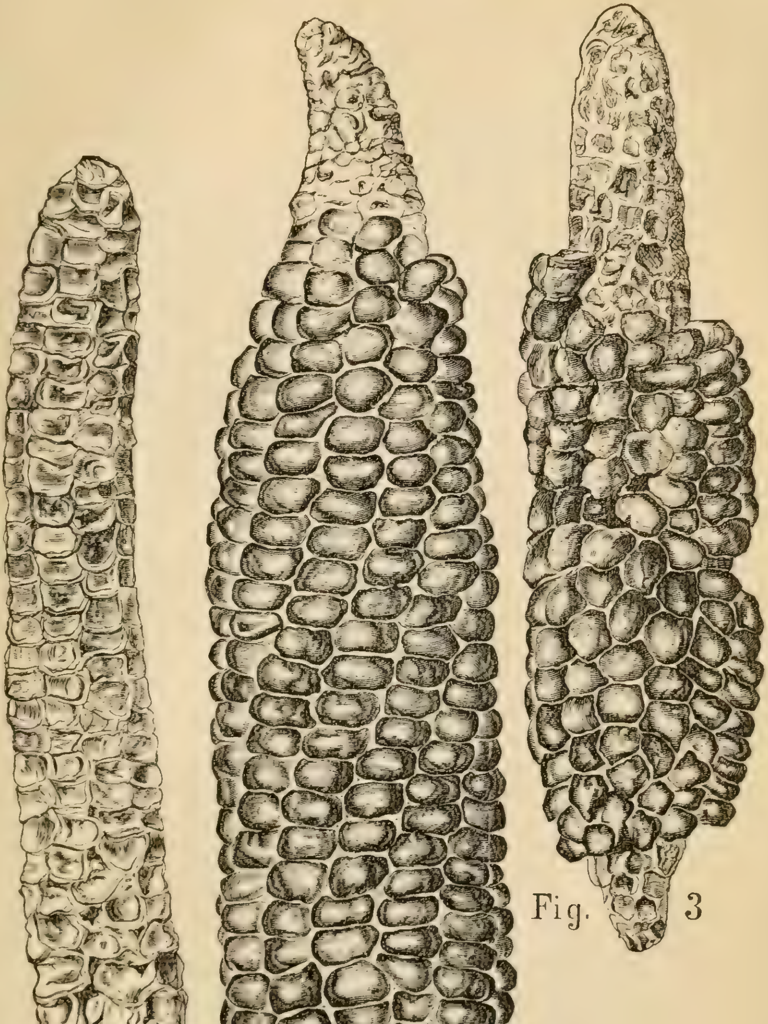


Fig. 1 Fig. 2 Fig. 3

INDIAN CORN (*Zea mays*).

mouth, but it soon softens, is quite sweet, and is readily masticated. All three of us, doubtless, will ever remember with pleasure the relish which our hunger gave to this singular bread. At one house the nicest dried peaches, of their own production, well cooked, were set before us, into the juice of which the bread was dipped, at the same time serving as a spoon. At another house the roasted mescal, dissolved in water, was set before us, in which to dip our bread or guagave rolls, the ends of which we bit off from time to time, after saturating them, until satisfied, each declaring the food excellent. A favorite mode of preparing corn is to boil it in weak lime-water, to remove the husk bran. It is then ground into a soft pulp, and made into bread like the above, but is not so palatable to the general taste. The corn, thus hulled, is often mixed with chopped meat, formed into cakes, and dried for future use. Often, when new corn is ground, it is mixed with pieces of meat, and red or green peppers, placed between soft corn husks, tied at the ends, and boiled. This dish is called by the Mexicans tomale, but is not acceptable to civilized palates. Corn meal is also made into attole or gruel, and, when mixed with sugar, or the flour of the mesquite, it is called pinole, and is much relished by all Indians. Water is sometimes added to it, forming a cooling, sweet, nutritious drink. To make this nicely, the corn must be carefully parched, then pulverized, and prepared as above. The raw meal is often made into a kind of bread, called tortillas by the Spanish. Some Indians prepare the roasting ears by stringing and drying them for winter. The Apaches, and many other Indians, toast their corn in baskets with much dexterity. This is effected by placing the grains and a few live coals or hot stones in the basket, and keeping up a brisk agitation, occasionally holding the open basket to the fire. The Indians are very fond of parched corn, and consume it in surprising quantities. Sometimes it is made into bread after being thus roasted. The Apaches cook their mush in rather flat wicker baskets, which are water-tight. They heat stones very hot, and, with wooden tongs, the ends of which are charred, take them up and drop them in the mush. As soon as cool, the stones are taken out, licked clean of the adhering mixture, and fresh ones take their places, and so on until the mush is cooked. The family then gathers around, and with the fingers scoop out the contents. The Navajoes have a national dish formed of pounded roasting ears, wrapped in the soft corn-husks, and baked in hot ashes. Corn bread, as made by some of the Indians, and baked in ashes, would fail to have an appetizing effect upon most people. The Navajoes are not very fastidious as to their food.

An intoxicating drink is made of corn by the Apaches, called tiswein. The grain is first soaked for twenty-four hours; a hole is then dug in the ground, generally in a wigwam, and some dry grass laid on the bottom; then the corn is laid in and covered with grass; warm water is sprinkled over four or five times daily; at night the family sleep on it to increase the warmth and cause sprouting, and in four or five days, it is ready for the next operation. It is then dried, pulverized, put into a kettle, and boiled five hours; when cooled, it is mixed with sugar and flour, and left to ferment for twelve hours, when it is ready to drink. If no sugar is at hand, the flour of the mesquite beans is used, or the sirup from the fruit of the *Cereus giganteus*. This is a strong drink, and is made whenever corn can be procured. The Indians living principally upon the chase, in their wild state, cultivate less corn than those settled in villages. Small patches are planted in the clearings in the woods, where the soil is easily worked, and there are no trees to cut down. As a sample of the farming of the Pueblo Indians settled in villages, it may

be stated, that on the Colorado River, in Arizona, they are in the habit of cultivating corn on the river bottom. After the high rise in June, they simply make holes in the moist ground for the seeds, and the plants are started three or more inches below the surface, so that the heat of the sun may not injure the tender corn. The ground is disturbed only sufficiently to enter the seed below the surface.

Kidney bean, (*Phaseolus.*)—A large bean growing wild among the mountains around Fort Whipple, Arizona. It is used, both green and dry, by the Apaches of that Territory. The root, being perennial, becomes very large.

Dock, (*Rumex.*)—This common plant of the Colorado River, Arizona, produces abundance of seeds, which are gathered by the Indians living along its banks, and ground into flour for bread. The bulky root is much used instead of bark for tanning fine hides. The local name of the plant is yerba colorado.

Wild rice, (*Zizania aquatica*, Plate 9.)—The Sioux call it pshu, and the Chippewas man-om-in. It is a constant article of food with the northern Indians of the lakes and rivers between the Mississippi and Lake Superior. This plant delights in mud and water five to twenty feet deep. When ripe the slightest wind shakes off the grains. After being gathered it is laid on scaffolds about four feet high, eight wide, and twenty to fifty long, covered with reeds and grass, and a slow fire is maintained beneath for thirty-six hours, so as to parch slightly the husk, that it may be removed easily. Its beard is tougher than that of rye. To separate it from the chaff or husk, a hole is made in the ground a foot wide and one deep, and lined with skins; about a peck of rice is put in at a time; an Indian steps in, with a half jump, on one foot, then on the other, until the husk is removed. After being cleaned the grain is stored in bags. It is darker than the Carolina rice. The hull adheres tightly, and is left on the grain, and gives the bread a dark color when cooked. The husk is easily removed, after being exposed to heat. In Dakota the men gather this grain, but all other grain the women collect. An acre of rice is nearly or quite equal to an acre of wheat in nutriment. It is very palatable, when roasted and eaten dry.

MISCELLANEOUS.

Staff tree, (*Celastrus scandens.*)—The Chippewa Indians use the tender branches of this climbing shrub, the *bois retors* of the French, or twisted wood, which is sometimes called *bitter-sweet.* It has a thick bark, and is sweetish and palatable when boiled.

Storksbill, (*Erodium cicutarium.*)—This plant, when young, is gathered and cooked, or eaten raw, by the Blackfeet, Soshones, and Diggers.

Unicorn plant, (*Martynia violacea.*)—The Apache Indians gather the half mature seed-pods of this plant, and cook them with various other substances. The pods, when ripe, are armed with two sharp, horn-like projections, and, being softened and split open, are used on braided work to ornament willow baskets.

Odontostemum Hartwegi.—A species of sea-weed used as an article of food by the Indians of the northwest coast.

Round-leafed sorrel, (*Oxyria digyna.*)—The leaves of this plant are chopped up with scurvy-grass or water-cress, and made into a kind of salad, which is allowed to ferment before it is eaten. The Alaska Indians are very fond of this dish.

Common purslane, (*Portulaca oleracea.*)—The Apache Indians eat this species of purslane raw. When they cook it at all, it is merely sufficient to wilt it.

PLATE XXVII.

[PLATE 9 INDIAN FOODS.]

WILD RICE (*Zizania aquatica*).

PLATE XXVIII.

[PLATE 10 INDIAN FOODS.]

Fig. 1

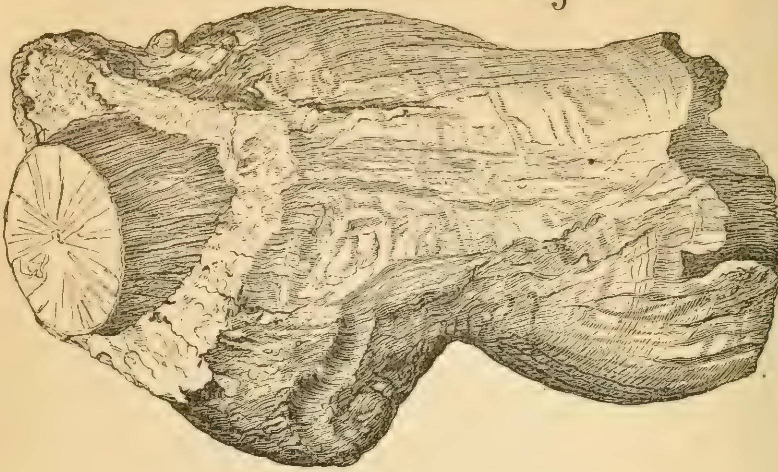
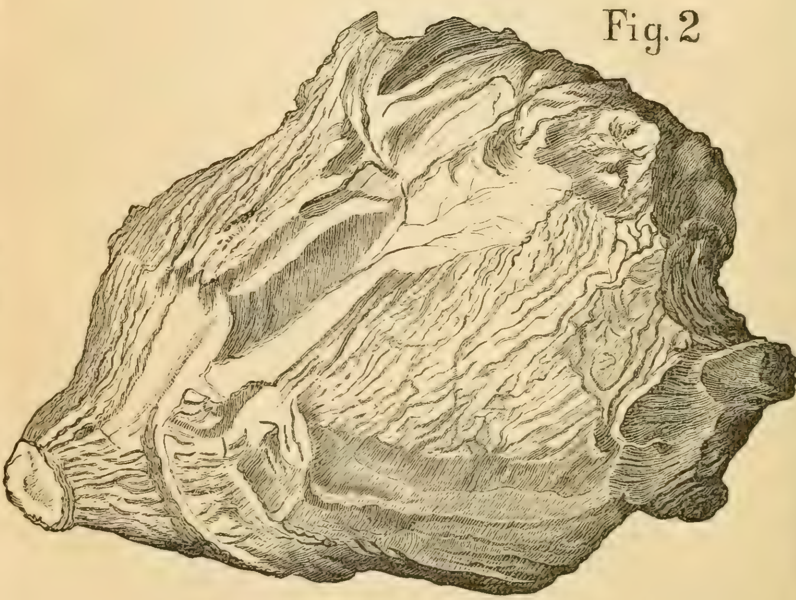


Fig. 2



TUCKAHOE, OR INDIAN HEAD (*Lycoperdon solidum*).

Palmetto, (Sabal.)—The Indians remaining in the Southern States, and the negroes, use as an article of food the embryo leaves of the palmetto, which are cut out of the top of the young plant, and boiled like a cabbage.

Sorrel, (Rumex.)—The leaf stalks of a species of rumex, or wild rhubarb, are much eaten by the Indians of Alaska.

Dandelion, (Taraxacum dens-leonis.)—The leaves of this plant are eaten raw or cooked by the Diggers of California and the Apaches of Arizona, who travel over a wide scope of country to find sufficient food to appease their appetite. So great is their love for this plant, that the quantity consumed by one person exceeds belief.

Clover, (Trifolium.)—This is eaten, cooked or raw, by the Diggers of California and Apaches of Arizona. The former tribe cook it by heating large stones and placing a layer of clover, well moistened, between the layers of stones. This attempt to adapt the food of ruminating animals to human wants involves the necessity of consuming it in very great quantities. Sometimes young onions and common grass are thus cooked with clover. The Apaches boil clover, young grass, dandelions, and pigweed together in a water-tight basket, heated rocks being put in and removed as they become cooled, until the mass is cooked. Where this clover is found growing wild, the Indians practice a sort of semi-cultivation by irrigating it and harvesting.

Stramonium or Jamestown weed, (Datura metel, D. stramonium.)—The first-named species grows abundantly on the Colorado River, in Arizona. The Mohaves gather the leaves and roots, bruise and mix them with water, and after being allowed to stand several hours the liquid is drawn off. It is a highly narcotic drink, producing a stupefying effect which it is not very easy to remove. The Mohaves will often drink this nauseous liquid, as they are fond of any kind of intoxication.

Honey.—The Winnebago and other tribes of the Indian Territory, near the borders of Texas, gather large supplies of wild honey, which is very abundant and much esteemed.

Bent grass, (Arundo phragmites.)—This species of reed, which grows abundantly around St. Thomas, in Southern Utah, during the summer months, produces a kind of white, sweet gum. The Utah Indians cut down the reeds and lay them in piles on blankets or hides, and let them remain for a short time to wilt, when the bundles are beaten with rods to release the gum. The small particles so detached are pressed into balls, to be eaten at pleasure. It is a sweet, manna-like substance.

Tuckahoe or Indian head, (Lycoperdon solidum.)—Two specimens of this fungus are in the collection of the Department of Agriculture—one from Nottoway County, Virginia, (Fig. 1, Plate 10,) and the other from Leroy, Kansas, (Fig. 2, Plate 10.) These singular fungous growths are subterranean and parasitic on roots of large trees. A piece of root is often inclosed in the mass. The form is irregularly globose, about the size of a man's head. It is very rugous, and filled with cracks; the color externally is ashy black; in the interior, white, or nearly so, of a starchy appearance, very firm, and breaks into irregular masses. The Kansas specimen is rounded in shape, with a black, rough exterior, and a white and compact interior. When broken it had the appearance of a mass of dried dough, full of fissures and very granular. Booth and Morfit's Cyclopedia of Chemistry gives the following under the article of Picquotaine: "A highly nutritious plant, used as food by Indians. It results from a disease of the *Psoralea esculenta.* Its composition is as follows: Nitrogenous matter, 4.09; mineral substances, 1.61; starch, 81.80;

water, 12.50." The following remarks relative to the Tuckahoe are furnished by Dr. John Torrey:

It was first brought to the notice of the public by Dr. Clayton, who sent it to Gronovius, under the name of *Lycoperdon solidum*, and, as such, described it in the Flora Virginica about one hundred and twenty years ago. Next it was described by the late Dr. Von Schweinitz, in his Synopsis of the Fungi of North Carolina, under the name of *Scleroticum cocos*. About the same time Dr. Macbride, of Charleston, South Carolina, sent to the Linnæan Society of London his observations on that fungus. Without being aware of having been anticipated by Schweinitz, I described it in the New York Repository about the year 1819, under the name of *Sclerotium giganteum*. I gave also a chemical analysis of it, showing that it is chiefly composed of a singular substance, which I named sclerotine. Braconoet, some years after this, described the same principle, which he called pectine. In the Synopsis Fungorum of Fries the fungus is called *Pachyma cocos*. In the Proceedings of the Linnæan Society of London is an account by Rev. M. J. Berkely of a large subterranean fungus that is sold as food in the streets of Shanghai, undoubtedly the same as the Tuckahoe.

Sand food, (*Ammobroma Sonora*.)—From *ammos*, sand, and *bromos*, food. This herbaceous and fleshy plant is of a dull orange color, parasitical on the roots of an unknown shrub, which grows in the State of Sonora, Mexico, in sandy wastes, near the head of the Gulf of California. The root upon which it lives is composed of thick, tortuous fibers, dilated near the extremity. This is the point of attachment to the plant from which the parasite draws its nourishment. The stems are two to four feet long, and three-fourths of an inch to an inch in diameter. The Papajo Indians are very fond of this root, which is eaten after being roasted upon hot coals or dried in the sun. It is often ground on a metate, (curved stone,) with mesquite beans, forming pinole. The fresh root, when gathered and cooked, is very luscious, and resembles in taste the sweet potato, though far more delicate. Rain seldom falls in the arid region producing this plant, and consequently it becomes both food and drink to the traveler, its roots being very watery when fresh. For description see Annals of the Lyceum of Natural History, New York, Vol. 8, June, 1861, by Dr. John Torrey.

Bearded moss, (*Alectoria jubata*.)—The Indians residing on the Columbia River, according to Dr. Morse in his report on Indian affairs to the War Department for 1822, subsist in summer on a kind of bread made of the long, hair-like lichen which grows on the spruce fir-tree, and which resembles spiders' webs in fineness. To prepare it for food, it is gathered from the tree, laid in heaps, sprinkled with water, and then left for some time to ferment. It is next rolled up into balls as large as a man's head, and baked for an hour in ovens in the earth. When taken out it is fit for use, but it is neither palatable nor nutritious.

Wheat, (*Triticum vulgare*.)—This grain was first introduced by the Spaniards among the Pueblo Indians, and forms one of their principal articles of food. So fond are the Apaches, Papajos, and Utahs of it that they will pick up individual grains which may have been left by animals on old camp-grounds, and will enter wheat fields, after white men have cleared off the crop, and glean the scattered kernels. The patient manner of the squaws, who prostrate themselves on the ground day after day to pick up the loose grains, shows plainly how highly they estimate them. The Indians of the Rio Grande, New Mexico, of the Gila and Colorado Rivers, of Arizona, with the tribes of California and Utah, are the principal wheat-raisers among the aborigines. The Pimos grow the largest crops in Arizona. In addition to what is retained for their own use, as food and for planting, they sell annually large quantities to the traders who have Government contracts for flour and grain, wheat being often fed to animals in this section. A lively grain trade is carried on by the whites with these Indians. Their wheat and

corn are sold by measurement, a tin-cup holding about two pounds being used. Twenty-five of these measures are worth 25 cents in silver. which the traders will sell at 7 cents per pound, after being reduced to flour. In 1867 one million of pounds were sold; and this year they have, no doubt, a large surplus stock on hand. As wheat producers, the Indians of New Mexico are the most successful. The mode of reducing the grain to flour is by rubbing it with a flat stone in a scarcely concave mortar or *metate*. This is performed by the females. The flour is mixed with water and salt, and kneaded into a rather stiff dough. A gentle fire is kindled under a rock, where an iron fan or flat earthen plate, supported by stones, is used as a baker of the tortillas or thin flaky bread. These tortillas are made as follows: The women take a small piece of dough and flatten it into a round cake, then throw it backward and forward between the palms, at the same time whirling it around, until it becomes wide and thin; it is then placed on the baker, and in a minute it rises up full of blisters, and when turned on the other side it is quickly done. This is probably the best way mere flour and water can be baked. Wheat, when parched, pulverized, and mixed with sugar or the meal of mesquite beans, is called pinole, and when mixed with water forms a cooling and nutritious drink. Flour made into gruel is called attole. Most of the Pueblo Indians lay by an extra supply of wheat, corn, and other grains, so that if one crop fails they will have seed for another year. Wheat is planted in hills, several grains in each, about one foot apart each way, and the fields laid off with ditches, so that water can be turned on to irrigate the crop.

Beans are largely grown, and are used green or dry, and the tender green pods are dried for winter use. Red peppers are universally grown in Sonora and New Mexico, and the pods while green are eaten with various substances, under the name of chille verde, while the dishes prepared with the red pods are called chille colorom.

Pumpkins, squashes, musk-melons, and water-melons have become not only articles of food but of commerce. As these plants belong to the same natural family, and are grown promiscuously in the same fields, one is nearly as good as another, so much do they cross or hybridize with each other.

CULTIVATED FRUITS.

Several varieties of fruit have been introduced among the Indians, and have not only become cherished articles of food, but also of commerce. Peaches, grapes, olives, pears, apples, quinces, dates, pomegranates, figs, &c., are the principal sorts. The tribes most benefited by the cultivation of fruit are those of the Indian Territory and the Pueblos of New Mexico, Arizona, and California. The quantities consumed and sold are very great. Other eatables have been acquired by them from intercourse with more civilized communities, from the Mexicans on one side and the white traders and immigrants on the other. Their most valuable lessons in agriculture and fruit-raising, however, must be credited to the patient teachings of the Jesuit missionaries.

ANIMAL FOOD WITH VEGETABLE SUBSTANCES.

The various tribes living on the shores of Alaska, as the Kaloshes, Esquimaux, &c., eat the raw flesh and blubber of the walrus and whale. The spawn of the herring in a putrid state is considered a great delicacy, and is eaten raw or dried. Some species of algæ (sea-weeds) are often eaten with this unsavory dish. The flesh of sea otter, fur seal, sea lion,

fish, and shell-fish, with cold tallow is, eaten raw or cooked, being frequently mixed with wild parsnips, some kinds of fucus, the licorice root, the stalks of a rumex or wild rhubarb, snake-root, with various berries, and formed into various dishes of food. The stomach of the reindeer, distended with well masticated willow sprigs, in a half digested state, is highly esteemed. This is dried over the fire or in the smoke of the huts for winter use, and when mixed with melted suet, oil, and snow, is highly relished. It is deemed a powerful antiscorbutic.

The various berries collected by the tribes of Oregon Indians are sometimes, for variety, mixed with the dried eggs of the salmon; also with crickets, dried and pulverized. The siphons of *Panopea excelsa*, a marine shell-fish, are used as food after being smoke-dried.

By the Diggers of California and the Plains grasshoppers are caught in great numbers. When the insect attains its best condition, the Indians select some favorable locality and dig several little pits, in shape somewhat like inverted funnels, the aperture being narrower at the surface than at the base, the object being to prevent the insect which chances to tumble in from hopping out again. The pits being ready, an immense circle is formed, the surrounding grass is set on fire, and the Indians, men, women, and children, station themselves at proper intervals around the fiery belt, keeping up a continual ring of flame, until the luckless grasshoppers are corraled in the pits or roasted at the brink. They are eaten after being mixed with pounded acorns, and constitute one of the national dishes. Grasshoppers are sometimes gathered into sacks saturated with salt, and placed in a heated trench, covered with hot stones, for fifteen minutes, and are then eaten as shrimps, or they are ground and put into soup or mush. This tribe also feed upon ants, catching them by spreading a dampened skin or fresh-peeled bark over their hills, which immediately attracts the inhabitants to its surface. When filled, the cover is carefully removed and the adhering insects shaken into a tight sack, where they are confined until dead, and are then thoroughly sun-dried and laid away. Bushels are thus gathered annually, and are not more offensive than snakes, lizards, and crickets, which the tribe also eat. Grasshoppers are pounded up with service, hawthorn, or other berries. The mixture is made into small cakes, pressed hard, and dried in the sun for future use.

A large fly deposits its eggs in the frothy edge of the surface of Mono Lake, in California, each of which when hatched becomes a larva of considerable size, and is called ke-chah-re by the natives. These larvæ when dried and pulverized are mixed with meal made of acorns, to be sun-dried or baked as bread, or mixed with water and boiled with hot stones for soup. The color of the powdered larvæ being similar to that of coarsely-ground black pepper, gives a forbidding appearance to the compound.

Among the Indians of Hudson's Bay it is the practice to prepare pemican, which is the common mode of condensing food among northern Indians. The lean meat is dried, pounded up, and mixed with melted fat, and put into buffalo-skin bags to congeal and become solid. Sugar is often added, or dried berries of various kinds. When other fruits or vegetables are not attainable the Indians are forced to employ a kind of lichen which grows upon rocks, having an egg-like appearance. It is boiled with pemican and dissolves into a glutinous substance, and it, or some fruit or vegetable, is held to be an indispensable ingredient in the mixture.

Raw fish eyes, the roes of salmon, and other small scraps are buried in the earth until putrid, and then eaten, cooked or raw. These sub-

stances produce a horrible stench when exposed to the air. The Chippewas are said to indulge in this diet.

The Sioux prepare a favorite dish, used at great feasts, called wash-en-ena, consisting of dried meat pulverized and mixed with marrow, and a preparation of cherries, pounded and sun-dried. This mixture, when eaten raw or cooked, has an agreeable vinous taste. To this compound is frequently added, when to be cooked, a kind of flour made from the root of *pomme blanc*, (white apple,) thus designated by the French Canadians, and derived from the *Psoralea esculenta*.

Among the Pimos Indians, as among the savages of Africa, tobacco worms, which are the caterpillars of *Macrosila Carolina*, are gathered and made into soup, or fried until crisp and brown. Vegetables, meal, or seeds are usually added to the composition when made into pottage. The writer has seen this tribe gather bushels of the worms for immediate consumption, or to be dried and pounded up for winter stores.

The review of the articles of food consumed by the Indians will show that many of the substances are not only distasteful but disgusting to civilized persons, and many, also, are not of a nutritious character. It is barely possible that there is a flavor in some of these undetected by the whites because untried; nor is it logical to believe that all articles which are favorites with the latter class should be necessarily so with Indians, or *vice versa*. Their senses are keener, it may be, to appreciate an obscure flavor to others undiscoverable. The ivory hunter on the bank of an African river, having killed a hippopotamus for the supper of his negro attendants, leisurely watches their proceedings in preparing the feast, and observes that the entrails, without being cleansed, are carefully preserved as the choicest morsel, and subsequently cut up and distributed in shares to the party according to rank. When slightly roasted they are devoured with unmistakable signs of enjoyment. Being disposed, philosophically, to inquire into the nature of things, the hunter tries the taste of the extraordinary food, and leaves on record that the savages are certainly not without reason for their preference. It is easy to understand how the wild creatures, impelled by gnawing hunger, out on the mountain side or on the unsheltered prairie, fearing the vengeance of the whites, and not daring to apply for food at the settlements, will have recourse to any description of organic matter, vegetable or animal, to appease hunger. Unusual substances are thus experimented with, and some rude process for making them more palatable is invented. A glance at the methods of cookery may raise a smile, but the ingenuity exhibited in many cases cannot be denied. These people carry their domestic arrangements with them in their wanderings, generally on the backs of the women, and cooking, provisions, and everything pertaining to their *al fresco* house-keeping must be extemporized on the spot. If the chase or fishing should fail, they must find substitutes in berries, herbs, roots, seeds, &c.; and fortunate is it for them if the season be propitious. In winter, if from improvident recklessness no store has been accumulated, starvation necessarily follows. The chances, at any time, of attaining a regular supply of food, are so precarious that it is not uncommon to find recorded observations of travelers concerning the gormandizing habits of the aborigines. This is not, however, universally the case, since the tribes which are settled on reservations and raise annual crops, and those receiving annuities, and many others, are to be excepted. The reports of the desperate expedients resorted to for sustaining life, by such tribes as the Diggers of California, who are of a low grade of mental organization, and of the enormous quantities of reptiles, insects, roots,

grass, and lichens which they consume, are unquestionably true. In proportion to the small amount of real nourishment contained in the articles, the bulk consumed must be increased. The stomach becomes distended and the visceral function overworked; the organs are enlarged to protuberant dimensions, producing a distortion which would be ludicrous were it not pitiable. It is a remark of military men who have been much with the Indians, that if they are fed much on the flesh and cereals and other adjuncts of the white man's table, they pine away and lead an abandoned and unhappy life, and that, confined to this fare, many would die as if visited by an epidemic. There is an unsatisfied craving within them for the rude fare of their wild life, for the coarse, bulky, precarious food of their younger days, for the messes of their tribe, however rude and unsavory they may appear to others. They hail, therefore, with a yell of pleasure, the opportunity to leap over the bounds of civilization into the wild scenes familiar to their childhood.

THE PRESENT THEORY AND PRACTICE OF MINERAL MANURES.

For some years past anxiety has been felt by cultivators of the soil in densely populated countries, as Belgium, France, England, and Germany, from a growing consciousness that the ordinary farm or cattle manure is insufficient to sustain the food growth of the cultivated land requisite to meet the demands of the present population, and the conviction has arisen that guano does not supply that deficiency, and that it is not a substitute for farm manure in many situations. Agricultural chemists during this time have been experimenting with new substances to be used as manure, either singly or as compost; their theories and views, as interpreted by Dr. Antisell, of this Department, are here presented. The high price of guano, and the knowledge that the supply of this substance from the present source must in a few years be exhausted, have influenced manufacturers to flood the market with all kinds of manufactured fertilizers, many of which are of little value, and the most of them but poor representatives of what they purport to be. The overwrought and exhausted condition of many lands in Europe on the one hand, and the necessity for raising a sufficient food supply for an increasing population on the other, have produced in some localities, and may shortly produce in all, an agricultural crisis, for which at present there is no remedy. The problem is, how to make the land produce abundant and continued crops without increasing the cost of food produced. This question presses very strongly on Great Britain and France. While the former by manufactures and commerce can stave off the crisis for a time, France, with her legion of small land holders, and no colonial market for manufactures, is more immediately dependent on the soil for the support of her population. Although our country is differently situated, and the "struggle for life" among our poorer population is not so severe as in Europe, the consideration of this question of obtaining fresh supplies of manure is of material interest to our people. What is the manure of the future to be? This question is to be solved within a few years. In old times, letting the land lie fallow restored it to fertility; but then the population was small, and the cultivation of a few acres more or less was not felt; now, as the population increases and land becomes occupied, fallowing must be

abandoned. Tull and Buel believed in deep cultivation, as enabling the soil to produce larger crops by supplying food more abundantly to the crops, and so it did; but it was costly and advanced the price of food, and after a while the ground would bear no more deep cultivation, not yielding an increased return commensurate with the increased labor.

Von Thaer in Germany and Boussingault in France were the ablest supporters of the view that organic matter (chiefly vegetable matter decaying) is the great pabulum of plants, and, if this is in sufficient amount in the soil, crops will grow luxuriantly. But even with abundant supplies of humus, as this vegetable matter is called, in the soil the ground deteriorated, less weight of roots and grain was raised, and the land became exhausted, or sick of the crops, as it is sometimes said. Then followed the belief that farm manure, the excrement of cattle and horses and the waste of fields, is the true fertilizer, and that if it is applied to the soil in sufficient quantity all crops will grow and produce abundantly. This belief now holds firm possession of the minds of the agriculturists of Great Britain and the United States, and the agricultural logic in a circle, heard in the after-dinner speech at the Farmers' Club, expresses it forcibly:—The more manure the more roots, the more roots the more cattle, the more cattle the more manure, and the more manure the more roots, and so on. It is very difficult to make the agriculturist see the error in this argument, or to convince him that everything that passes through the body of a four-footed animal is not manure or food for plants. Nothing of late years has more fully demonstrated the fallacy of depending upon farm manure as the only and sufficient fertilizer for farm crops of all kinds, than the experiments of Georges Ville, carried on near Paris during the past ten years, and, although but little has been heard of them outside of that country, they have taken a deep hold on the public mind in rural France, and therefore deserve to be brought fully before the farmers of this country. While Liebig has demonstrated that barn-yard manure is the most complete of all natural manures, as they may be called, he has also shown us that it does not suffice to restore to the earth all the substances which have been abstracted from it, because the manure is made only from the straw and the residuum of the food consumed by cattle, while a large portion of the grain, the live cattle, and the wool of the flock, is sold off in the market, and returns nothing to the soil. Farm-yard manure, therefore, will not wholly suffice as a fertilizer, and the necessity for complementary manures arises; that is, the use of chemical substances which shall supply those mineral elements which have been abstracted, and are not in the barn-yard manure. Perhaps too much reliance has been placed upon the use of farm manure alone as the only fertilizer necessary. It is difficult to make American farmers think otherwise, and if the experiments and results given here should shake their faith and sole dependence on it, some benefit may accrue from this presentation of the subject. Liebig uses the following strong language in reference to the experimental farm at Hohenheim:

The history of the farming at Hohenheim is particularly worthy of attention. Up to 1864 the directors placed at the head of the establishment were what people called practical men; that is to say, the management of the farm was intrusted to agriculturists, who knew how to work the soil with profit, meaning by this word profit the amount of money got out of the earth, without reference to the condition in which the earth has been put by this so-called profitable farming * * * At Hohenheim complete accounts are kept of the yearly yield, and the results of successive years give no uncertain reflex of the condition to which the soil is reduced. According to the rules adopted in the management of this farm, it was necessary that the conditions of fertility should be found perpetually in the soil, which should have been inexhaustible. According to these principles, success should solely depend upon the skill and dexterity

of man, and consequently it was regarded as useless to employ manures drawn from other sources. The Hohenheim managers drew from their lands large supplies, but took no care to compensate the soil by imported manures. But it soon appeared, and in an alarming manner, that their skill, so highly prized, had lost its power over these fields. So long as the soil remained rich, it reciprocated the care bestowed upon it; but, when it became poor, appeals were in vain. The directors imagined that it was nature that had changed; that climate and season, before so favorable, had become unaccountably hostile to their efforts; nevertheless, and as if they thought that farm manure produced crops, and that they only wanted this material in order to obtain better harvests, they sought to remedy the evil by making a larger quantity of farm-yard manure, which they were able to do. During the years 1832 to 1841 they employed at Hohenheim only one-fifth of the farm-yard manure, and yet obtained from the same amount of land under cultivation 20 per cent. more corn than in the years 1854–1860. It is easy to understand this decrease. By the sale of cereal produce, the fields of Hohenheim lost, between 1821 and 1860, 108,000 pounds of phosphoric acid which had not been restored; the absence of one of the elements which are specially essential to the production of wheat became very conspicuous in the diminution of the harvests. To keep the harvests constantly to the same level, it would be necessary to give to the fields of Hohenheim 236,000 pounds of bone dust; so the working of the Hohenheim lands, being considered a model of excellence and recommended for imitation, has proved very clearly that when nutritive principles are carried off the farm, and no compensation is given to the land, the soil, however good, will, little by little, lose its productiveness.*

Almost daily in the agricultural journals we read of experiments made with chemical manures, and the terms chemical manures and complementary manures have become stereotyped phrases, unknown thirty or forty years ago. In fact it was not known then how plants grow, or what they feed on. It only needs a slight glance back to the opinions of the guiding spirits in agricultural progress to ascertain how vague and unsatisfactory was the information on mineral substances as food for plants. While we are yet in much obscurity in regard to plant food, we are still far beyond the first and second quarter of this century in our knowledge of the wants of growing plants. Sir Humphry Davy was much in advance of his time on notions of agricultural chemistry, yet even he had very vague notions on the relation which the mineral matters of the soil bore to the growing plant, and his idea of a manure was that it should be of an animal or vegetable nature. In his first lecture he says:

"Plants are found by analysis to consist principally of charcoal and aeriform matter," and that the principles which they yield, on burning or distiliation, were derived from elements "which they gain either by their leaves from the air or by their roots from the soil. All manures from organized substances contain the principles of vegetable matters, which, during putrefaction, are rendered either soluble in water or aeriform, and in these states they are capable of being assimilated to the vegetable organs. No one principle affords the pabulum of vegetable life; it is neither charcoal nor hydrogen, nor azote, nor oxygen alone, but all of them together in various states and various combinations."

Here, while he enunciates broad principles truly, he narrows the nutrition of the plant to carbon, hydrogen, azote, and oxygen, and their combinations as the essential necessities of a manure, and says that vegetable substances decomposing are the true manures, because they yield these elements. When he treats of gypsum, alkalies, and saline substances, or simple manures, as he calls them, he says their action is very obscure, and likens them to condiments or stimulants in the animal economy, which render the common food more nutritive, but never states that they are the food of plants. He approaches closely to Liebig's idea when he alludes to the operation of the true alkalies, whose mode of action he thought was most simple and distinct. He says: "They are found in all plants, and may, therefore, be regarded as their essential elements." But he loses this idea and adds, "they may be useful in introducing various principles into the sap of vegetables which may be

* Translation from vol. viii, International Jury Reports of Paris, 1867; p. 221.

subservient to their nourishment." Chalks, marls, and powdered limestones were, in his view, only amendments to the soil, and not any material which could supply needful food to plants. He writes: "They act merely by forming a useful earthy ingredient of the soil." Thus Davy gave the stamp of his genius to the extension of the idea that manures are improvements or amendments to ground in the first instance, and that their value as food materials to the plant is only secondary.

Jethro Tull was the first writer who brought forward the idea that minute earthy particles supply the whole nutriment of the vegetable world. He anticipated Liebig in the grand idea that the mineral matters of the soil are the food of plants; but his notion of manures was that they act in no other way than in ameliorating the texture of the soil; that in fact their agency is mechanical. "All sorts of dungs and compost," writes Tull, "contain some matter which, when mixed with the soil, ferments therein, and by such ferment dissolves, crumbles, and divides the earth very much. This is the chief and almost the only use of dung, for, as to the earthy part of it, the quantity is so very small that, after a perfect putrefaction, it appears to bear a most inconsiderable proportion to the soil it is destined to manure, and therefore, in that respect, is next to nothing." This view of Tull, which was first published in 1753, was given out when he was unable to support it by any experimental proof; and the idea, therefore, fell lifeless, to be resuscitated by Liebig, with the many proofs which he adduced.

Nearly thirty years ago Liebig pointed out that farm-yard manure is not indispensable; that it may be successfully replaced (although not then economically) by the employment of various substances of mineral origin, bodies containing nitrogen and those devoid of that element, selected from those which can yield to plants all the constituents which they need for development. Since that time the experiments of Kuhlmann, and subsequently those of Boussingault, Barclay, Hannan, Gilbert and Lawes, Schattenmann, Turner, Wilson, and others, have confirmed the views of that great chemist, and demonstrated the special fact that nitrates and ammonia salts are able to supply to the soil all the nitrogen necessary to endow it with fertility; and finally the more recent results of Georges Ville prove that these nitrates and ammonia salts, united with phosphate of lime, with potash salts and gypsum, are sufficient to replace farm manure where it cannot be supplied.

It will be seen in this summary that no mention has yet been made of *humus*, or the decomposed vegetable matter of varied composition known under that name. Boussingault, in his work, *Rural Economy*, treating of the rotation of crops, (Chapter 7,) gives his view as to what the food of plants consists of: "It is known that the atmosphere and the organic matters diffused through the earth concur simultaneously to maintain the life of plants, but how far each contributes is undetermined;" but of the real practical value of humus he had no doubt. Some of Liebig's strongest efforts were directed to show that it may be dispensed with as a food of plants, and consequently as a manure; and the experiments of Gilbert and Lawes and of Ville seem to show that humus is not absolutely necessary as an amendment to land; yet, after the lapse of twenty-nine years, the statement of J. W. Johnston, of England, as to the importance of humus in the soil, is as true now as then:

It is consistent with almost universal observation that the same soil is more productive when organic vegetable matter is present than when it is wholly absent. In fact, humus acts in a way so different from the chemical substances which Liebig and others have shown may be substituted for it, that it cannot be fairly estimated when contrasted with them. Humus gives physical qualities to the soil which cannot be bestowed by any of the food materials of plants. It places a soil in relation with the

forces of nature, with heat, light, electricity, and with *energy* generally—with that form of it called *vital force*—and thus regulates the rate and mode of growth in a manner wholly unknown to mere chemical food elements. Thus, humus retains the moisture in a soil; by its slow decomposition it evolves heat, and raises the temperature above that of land not supplied with it. Thus heat and moisture are gradually offered to the growing vegetable germs. By its darker color it absorbs the solar heat, which is for a time retained, and is therefore converted into energy or vital power by the presence of humus. A gentle development of carbonic acid takes place, which, dissolved and retained by the moist humus, dissolves phosphate and carbonate of lime, and renders even alkaline soils more readily soluble. And further, this carbonic acid decomposes the double and trisilicates in the soil, liberating the silica in a finely-divided and soluble form suitable for the growth of cereals.

This is a long list of properties dependent upon the presence of humus in the soil, which are too much overlooked by the upholders of the mineral-manure theory.

When we acknowledge that to Liebig belongs the idea of employing mineral agents to increase the fertility of soils, it must not be forgotten that marling lands, or applications of lime carbonate, is not new, and was practiced long before the birth of that illustrious chemist. Plaster or gypsum was similarly applied by our own Franklin and others the latter half of the last century. So also the use of common salt, bone-dust, and even guano, is little else than illustrations of the practice of supplying mineral principles to the soil. These were applied from some vague knowledge that the land was somehow benefited by their action; but the idea of a mineral food for plants—the "mineral theory" as it is termed—and its application to practice dates no farther back than 1839, and justly belongs to Liebig; yet the first essays in this direction were little else than failures. Liebig believed that rain-water carried off much of soluble saline matter from the land, or sweeps it down into the sub-soil out of the reach of any but the deepest-rooted plants. He thought also that, as cereals require alkalies and silica, it would be best to supply these after they had been fused together, as occurs in glass-factories, so that they might very slowly decompose, and keep up a gradual but moderate supply of the necessary mineral food. He alludes in the chapter on soils in his Agricultural Chemistry (1840) to the ash of straw from the bake-ovens of Hesse, and to the use of soluble glass as a mode of giving both alkalies and silica to plants. He writes:

A compost manure, which is adapted to furnish all the inorganic matters to wheat, oats, and barley, may be made by mixing equal parts of bone-dust, and a solution of silicate of potash, (known as soluble glass of commerce,) allowing this mixture to dry, and then adding ten or twelve parts of gypsum, with sixteen parts of common salt. Such a compost would render unnecessary the animal manures, which act by their inorganic ingredients.

Here is the idea of replacement of organic by mineral manures, which lies at the bottom of the system of modern manuring.

Liebig's fear of exhaustion of soils by rain-water or drainage carrying off soluble saline matter proved to be groundless; for Way showed that arable land, by virtue of the clay which it contains, possesses a remarkable absorbing power, rendering it capable of appropriating and fixing within its particles the important saline matters and nitrated compound suitable for vegetable growth, presented to that clay by the water holding them in solution. Liebig's fear of lixiviation of the soil was groundless, and a growing appreciation of this circumstance—the absorbent and retentive power of saline matter by the clay in a soil—led Kuhlmann, Boussingault, Gilbert and Lawes, Voelcker, and above all, Georges Ville, to adopt with marked success the employment of various saline matters as substitutes for farm-yard manure as a fertilizing agent. Hence to the idea of "mineral theory" is now superadded that of "chemical manures." It is, however, to the exertions of Ville that the

subject of *special* manures has received so much attention of late; for which exertions he has been rewarded with the position of extra professor *(professeur-administrateur)* in the Museum of Natural History in Paris, where he delivers a course of lectures annually, and subjects his theories to practice on an experimental farm at Vincennes, established by the Emperor upon land adjoining the imperial farm. This farm occupies a surface of three hectares,* divided into five parallel lots, each of which is subdivided into twenty-four parcels of land. The manures are made with chemically pure ingredients, representing the constituent minerals of plants. Operations were commenced here by Ville in 1860, the results of which constitute the theme of his yearly lectures in the museum. The principle at the basis of his experiments is to supply as nourishment for plants those principles or salts which, according to analysis, are a part of their composition, and therefore are necessary for them; and as the species of plants may be numbered by the thousand, the manure or mineral supply must vary accordingly.

The rule of this modern school, headed by Liebig, Lawes, Voelcker, and Ville, is, therefore, to supply to the land more phosphate, more potassa, and more lime than the harvests remove from it; and, according to the statement of these analyses, to furnish those elements which roots need and absorb. The rationality of the theory which underlies this rule ought to recommend it to public favor. It is only necessary to know beforehand what mineral element a plant requires, and it would appear at first sight a very simple matter to have this question determined. All our common crops of food for man or cattle have been analyzed by accurate and reliable chemists. Select one of these and adopt it as the standard. But in looking over the several analyses of any simple plant, made by different chemists, we do not find that uniformity of results which is desirable to render them reliable as exact statements. The substances present are found to differ very considerably in their nature, as well as in amount, and we have learned that some of this difference is due to varieties of soil, some to differences in the manure, and some to changes of climate and season; that is to say, to greater or less continuance of solar heat and varying amount of rain-fall. A plant is, to some extent, like an animal; if plenty of food is supplied it will take up more than it needs; and if there is a deficiency of one element it will take up another to supply the vacancy. Here, then, is a difficulty at the outset; how much of the quantity taken up is the proper sum for healthy existence, and how much is superfluity; and, since the elements vary in their nature, as found in plants grown in two localities, we are considerably in the dark as to which is the necessary and which the complementary element. We need greater exactness, and this we shall not attain until each plant is considered an individual requiring a certain amount of soluble food for its growth and development; until, in fact, we treat it like an animal or man. Man requires, when of average weight, (140 pounds,) thirty ounces avoirdupois of solid food daily, one-fifth of which, at least, should be albuminous and four-fifths amylaceous; about sixty grains of salt, and four pints of fluid. Just such a formula is necessary for *each* species of plant, and in order to obtain it exactly we have, by experiments yet to be made, to determine the *essential* and the *supplementary* food of the species. We know that soda will replace potash, and that magnesia may replace lime, but we do not always know under what circumstances and how far these aliments best subserve the ends for which we grow the species.

* Hectare, 2.4711 acres.

Extended analyses of American food crops are needed, for those made in one country cannot be made a rule for another country, where latitude, solar heat, and meteorologic influences are very different. The plant differs from the animal in this: the animal heat is developed by changes within the animal, and the latter is nourished and developed in proportion to that internal temperature, the sources of which are *within;* in plants the sources are *without.* The chemical changes which are continually going on in the growing plant are of that smaller amount which is not sufficient to increase the temperature of the plant; the energy displayed in the growing plant is expended in the formation of lignine, starch, gum, sugar, and proteine bodies, and in the evolution of carbonic acid and other gases, and thus none of it appears to *warm* the plant, except in those rare instances of inflorescence in a few species. It is the external temperature which warms the plant; and, as the solar heat augments or lessens, so do the physical processes of osmose absorption, selection, &c., proceed with more or less energy as the external heat varies. Hence, before we can give a formula for what plants need, it will be necessary that a large number of chemical analyses should be made. The teachings of Liebig have been carried into experimental practice in France, by Ville, who started with the idea that the mineral elements of the soil are the true and only food of plants; and, if these minerals are not present or in sufficient quantity, they must be added; and that manures, therefore, must be chiefly mineral. To explain this practice a few preliminary observations should here be presented. The elementary forms of matter which plants require are narrowed down to fourteen, four of which are organic, and ten mineral or inorganic, viz, carbon, hydrogen, oxygen, and nitrogen, organic elements which represent ninety-five parts in a hundred of the composition of plants; phosphorus, sulphur, chlorine, silicium, iron, manganese, lime, magnesia, soda, and potassa, mineral elements, rarely exceeding five per cent., but they are necessary and must be present. The organic elements are supplied as follows: the carbon chiefly by carbonic acid, partly by humus in the soil; the hydrogen and oxygen by water, (rain,) and the nitrogen by the nitrogen and the ammonia in the air, and by ammonia and nitrates in the soil.

The inorganic elements, ten in number, are not equally absorbed by plants; some of them in so very small proportion that all soils are amply supplied with them; such are sulphur, silicium, manganese, and iron. In fact, of the whole series of elements, organic and inorganic, only four need to be added in quantity as a manure, namely, nitrogen, phosphoric acid, (phosphorus,) potassa, and lime. The phosphoric acid may be supplied by bones, apatite, phosphorite, coprolites, fossils, marls and remains, and greensand. The potassa from the primary or crystalline rocks, as the granites and feldspathic rocks, which constitute chains of mountains, and yield 10 to 15 per cent. of potassa; from sea water, which, in defect of other sources, may, by Balard's process, have its potassa extracted; and from saline deposits rich in potassa, such as those at Stassfurth in Prussia. The lime from the usual sources of gypsum, marls, limestones, and other calcareous substances. Out of compounds containing these four elements, Ville forms his manure, which, because it supplies all that is needed, is termed by him the "complete manure," (*engrais complet.*) The proportions in the complete manure are:

	Pounds.	Ounces.
Superphosphate of lime	8	14
Nitrate of potassa	4	7

	Pounds.	Ounces.
Sulphate of ammonia	5	9
Sulphate of lime	6	10
	25	8

This corresponds to 12 kilograms,* French weight, costs three francs, and is recommended for an are† of land. All these substances may not be wanting in the soil, nor be needed by the crop; hence any one or more of them may be omitted, still preserving the formula with the residual components. For example, there is the manure without potassa, in which is simply omitted the amount of nitrate of potassa; the manure without phosphate, in which is omitted only the superphosphate of lime; and so of the remainder, which class he calls *incomplete* manures. The term *complete*, as applied to a manure which is intended to contain only four out of fourteen necessary elements, is very inexact, and calculated to throw discredit on the efforts of Ville. No doubt many lands are rich enough in sulphates, chlorides, magnesia, and iron not to need those matters which Ville neglects to supply, but that does not lessen the necessity for a complete manure containing *everything* which the crop requires; with less than that it is incomplete, as is his second class. Ville has applied his manures, complete and incomplete, with results which seem to support the views of the school of Liebig.

The experiments of Kuhlmann, published in 1843, and confirmed by subsequent trials of other agricultural inquirers, have amply proved that ammoniacal salts and salts of nitric acid (nitrates of alkalies) furnish nitrogen as abundantly and rapidly as do the nitrogenized principles in farm manure, and that they may be used when ammonia is needed for a growing crop.

Ville has ingrafted on his practice of manuring the idea that nitrogen may be assimilated by vegetation under three forms: 1. In the state of ammonia or its salts; 2. In the state of a nitrate; 3. In the state of gaseous nitrogen from the air. Each of these three forms presents advantages to certain species. Thus the ammonia for wheat, the nitrates for beet-roots, and nitrogen in its gaseous form for leguminous plants, as clover; so that the amount and the form in which the nitrogen is supplied may vary with the crop. The sulphate of ammonia and the nitrate of soda are the only two salts which can be used economically. The sulphate of ammonia yields 20 per cent. of nitrogen, and the nitrate of soda 15 per cent. On account of their concentration and ready solubility, they require to be mixed with four or five times their weight of fine dry clay or mold; animal debris may replace these salts. By their slow decomposition a loss of ammonia occurs equal to 30 per cent., which escapes into the air as nitrogen gas, a loss which happens with farm manure. On a hectare of land in wheat, those manures were applied with the following result, the weight of grain being in hectoliters:‡

With complete manure	39	hectoliters.
With complete manure, without lime	37	"
With complete manure, without potassa	28	"
With complete manure, without phosphate	24	"
With complete manure, without nitrogen	13	"
Land without manure	11	"

This soil already contained, in 100,000 parts, 984 parts of lime, 53 of potassa, and 45 of phosphoric acid.

* Kilogram, 2.204737 pounds. † Are, 0.0247 acre, or 119.6 square yards.
‡ Hectoliter, 2.83782 bushels.

In the Department of Somme an experiment on beet-roots afforded, (according to E. Marchand, in the Memoirs of the Imperial and Central Society of Agriculture of France, 1866,) in roots:

With 50,000 kilograms of farm manure	35,000 kilograms.
With complete manure	51,000 "
With complete manure, without lime	47,000 "
With complete manure, without potassa	42,000 "
With complete manure, without phosphate	37,000 "
With complete manure, without nitrogen	36,000 "
Land without manure	25,000 "

These results accord with the preceding.

An experiment made within the tropics, at Guadeloupe, on the sugar cane, yielded per hectare of canes, stripped of leaf—

With complete manure	57,600 kilograms.
With complete manure, without lime	50,000 "
With complete manure, without potash	35,000 "
With complete manure, without phosphoric acid	15,000 "
With complete manure, without nitrogen	56,000 "
Land without manure	3,000 "

This last experiment points to land already endowed with enough of assimilable nitrogen, but demanding the active intervention of potash and phosphoric acid to give abundant harvests.

By subjecting small plots of land, as specimen types of extended cultivation, to trial essays, Ville easily arrived at the power of production of the land and its particular need of each fertilizing agent to put it in a condition to yield full crops. This, in fact, is what is going on everywhere in Germany at the various agricultural experimental farms, *(versuch-stationen.)* The repetition and extension of the plan might be a duty of the agricultural colleges of this country. That Ville has distanced all other experimenters in showing the particular value of each mineral salt in increasing the produce of the land, there is no doubt; and E. Marchand attests the value of the influence of Ville's teachings upon various soils of France. In the Department of Drome a rocky hillside was grubbed for experiment, and it gave, without manure, 2½ hectoliters of wheat—scarcely the seed used. With the special wheat manure, it yielded 30 hectoliters. Ville's formula for this wheat manure is:

	Kilograms.	Value in francs.
Acid phosphate of lime	600	96
Nitrate of potassa	400	248
Sulphate of ammonia	255	102
Sulphate of lime	350	7
Total cost		453

In Champagne, uncultivated land, not worth 170 francs the hectare, yielded, with 1,200 kilograms of this special manure, 33 hectoliters of wheat; with 100 cubic meters* of farm manure, it produced only 13 hectoliters. Land producing without manure only 2½ hectoliters of grain, gave 8 hectoliters under the influence of 40,000 kilograms of good farm manure, and 28 under the influence of the wheat manure. Masson and Izarn, at Evreux, produced, with the complete manure, 40 hectoliters of wheat, when, with 30,000 kilograms of manure, they obtained only 19 hectoliters. Land producing 8,000 kilograms of potatoes when manured with 35,000 kilograms of barn-yard manure, gave 16,000 kilograms, or exactly double the product, with the complete manure.

* Meter, 1.09363 yard in length.

A document published by the Central Society of Agriculture of Belgium describes a piece of land of a sugar plantation in the Commune of Visé (Province of Liege) which had become so beet-sick that neither manure nor rotations could produce any root fit for manufacture. This piece was divided into two portions, on one of which Ville's chemical beet manure was used, and on the other a strong supply of good farm manure was applied. During the early growth the difference was so apparent as to astonish the workmen. At the harvest 39,520 kilograms of uniform excellent roots were taken off the Ville portion, while from the barn-manured piece only 18,200 kilograms of inferior, stunted roots were obtained. It would be easy to multiply the recital of results made in different parts of France, all showing the real value of these mineral manures.

To obtain the utmost value of each mineral in the manure, Ville modifies his formulas. Thus, in a four-year shift, comprising the rotation of beets, wheat, clover, and wheat, he prefers to employ each year the following manures:

First year, beet root: Acid phosphate of lime 400 kilograms; nitrate of potassa, 200 kilograms; nitrate of soda, 400 kilograms; sulphate of lime, 300 kilograms.

Second year, wheat: Sulphate of ammonia, 300 kilograms.

Third year, clover: Acid phosphate of lime, 400 kilograms; nitrate of potassa, 200 kilograms; sulphate of lime, 400 kilograms.

Fourth year, wheat: Sulphate of ammonia, 300 kilograms.

The whole cost of these manures in France is 770 francs, equal to a yearly outlay of 192 francs 50 centimes. We watch with intense interest the working out of this agricultural problem in France, as it involves two very important considerations, namely: 1st. The use of chemical substances as manures, given in exact weights and in variety suitable for rotations; 2d. Of the sole dependence upon these to the neglect, either partial or total, of the use of barn manure, and of a supply of vegetable matter in the soil.

Two questions force themselves upon the consideration of those who look on this French experiment, viz: 1st. Can land be treated indefinitely to raise crops by the use of chemical manures alone? 2d. Is it advantageous, in a financial or economic point of view, to employ chemical manures? The first question is one which no argument can decide; it is one to be settled by repeated experiments. If solved in the affirmative, it is a very important step in advance in practical agriculture. The second question can be decided much sooner. There are, already, warning voices raised from different localities in France that, with the present prices of chemical substances, these mineral manures cannot compete with those of the farm-yard. In that country ammoniacal salts cost 2 francs the kilogram; insoluble organic matter, 1 franc; insoluble phosphate, 25 centimes; soluble phosphate, 75 centimes; potassa, 60 centimes; pure lime, 1½ centime; and Peruvian guano 33 centimes the kilogram. Whenever chemical manures exceed the preceding rates to any extent, they will cease to be remuneratively employed. A little time will settle this question, also. Meanwhile, the well-known fact of soil exhaustion is apparent, and we should take to heart the following language of Liebig:

> The visible, gradual deterioration of the arable soils of most civilized countries cannot but command the serious attention of all men who take an interest in the public welfare. It is of the utmost importance that we do not deceive ourselves respecting the danger indicated by these signs as threatening the future of populations. An impending evil is not evaded by denying its existence, or shutting our eyes to the signs of its approach. It is our duty to examine and appreciate the signs. If the source of the evil is once detected, the first step is thereby taken to remove it forever.

We are in the transition state of agricultural theory and practice; we may at present believe that Liebig and Ville and Lawes have under-estimated the value of humus and of barn-yard manure, and have over-estimated those soluble saline preparations which Ville's chemical manures contain; but these men are still working out their problem, and if successful in proving their position they will have dashed our idols to the ground, and as converts to the new faith we shall have no desire to raise them. The science as well as the practice of agriculture is progressive.

CURRENT FACTS IN AGRICULTURE.

FERTILIZERS.

Manufactured fertilizers at the South.—A letter to the Department from Mr. Lawrence Sangston, president of the Maryland Fertilizing Company, of Baltimore, Maryland, gives some idea of the extensive use of manufactured fertilizers at the South. He states that during about four months from December, 1869, to April, 1870, 30,000 tons of manufactured fertilizers passed through Charleston, over the South Carolina Railroad, about one-half of which was manufactured in that city. During the same period the Georgia Central Railroad carried from Savannah 47,000 tons; and about 25,000 tons were forwarded from other ports in Georgia, South Carolina, and North Carolina, making a total of 102,000 tons, bearing a valuation, at points of delivery, of $7,000,000.

A large number of companies and individuals, near Charleston, South Carolina, are engaged in mining and preparing crude phosphates for shipment. Mr. Sangston says: "The South Carolina phosphates are fast supplanting those of the West Indies. Being similar to the ordinary bones or bone-ash of commerce, they dissolve more easily and in weaker acids than the mineral or volcanic phosphates of the West Indies, and their comparative freedom from iron or alumina enables the manufacturer to produce a better article at no greater cost. They are used exclusively in the Charleston manufactories, and in fully three-fourths of those in the Northern States they are used wholly or in part. Nearly every ship loaded at Charleston with cotton for Europe takes two to three hundred tons as dead weight; and occasionally entire cargoes are sent to England, Scotland, and Ireland. Large orders for France and Germany were unfilled at the commencement of the European war. A recent Spanish paper states that—

> There is about to be built in Valencia an establishment for the manufacture of "miners' artificial guano." This new product, which is composed of South Carolina phosphatic deposits, subjected to a treatment of sulphuric acid and sal ammoniac, is destined to become a formidable rival of the Peruvian guano, large quantities of which are consumed in that province.

Shipments of fertilizers from Chicago.—A recent statement of the amounts of manufactured fertilizers shipped south and east from Chicago during several years past shows the annual average to be 6,000 tons. The material from which these fertilizers are manufactured is in very large proportion furnished by the slaughtering establishments of that city.

Imports of guano.—The first cargo of guano imported into this country was received about a quarter of a century ago. The demand grew rapidly, and in the year ending June 30, 1848, the receipts amounted to 1,013 tons, increasing in the following year to 21,243 tons. During the

ten years ending June 30, 1860, the total imports of guano into the United States amounted to 842,787 tons; the amount reëxported during the same period being 71,788 tons. The imports of 1854 and 1855 were exceptionally large, in the former year reaching 175,849 tons, and in the latter year 173,961 tons. The following is a statement of the amounts of guano imported into the United States during the decade ending June 30, 1870, and the amounts reëxported during the same period:

Years.	IMPORTED.			REËXPORTED.		
	Tons.	Value.	Average value per ton at ports of shipment.	Tons.	Value.	Average value per ton.
1861	112,202	$449,822	$4 01	2,455	$88,818	$36 17
1862	22,089	195,488	8 85	1,460	55,039	37 70
1863	2,587	28,288	10 93	56,324	3,270,292	58 06
1864	9,568	138,555	14 48	14,064	849,668	60 41
1865	17,241	273,109	15 85	1,669	83,668	50 13
1866	37,464	397,184	10 60	240	15,595	64 98
1867	76,770	1,670,493	21 76	80	5,110	63 88
1868	47,586	1,219,519	25 62	1,190	71,793	60 33
1869	13,329	204,348	15 33	156	5,744	36 82
1870	48,749	1,415,519	29 04	59	2,700	45 76
Total	387,585	5,992,325	15 46	77,697	4,448,427	57 25

The import values, of course, represent the cost in the countries from which guano is received. The Peruvian Islands have afforded the chiet supply; the British West Indies ranking next in importance as a source of supply during the last ten years. During the years 1867–'70, besides the reëxports above stated, there were also exported 3,755 tons, valued at $86,610, the product of territory of the United States; and in the years 1869–'70 there were received 32,690 tons, valued at $645,717, the product of islands, &c., belonging to the United States. Such quantities as were received from like sources in years previous to 1869 were merged in official statements of imports. A large proportion of the total receipts of the last five years has been absorbed in the manufacture of artificial fertilizers, but the use of guano for this purpose is stated to be now on the decline.

Manufacture of bone meal. At the New York Farmers' Club, in reply to inquiries concerning the supply of bones and the manufacture of bone meal and flour, Mr. J. B. Lyman stated that in cities, on an average, the feeding of 20,000 persons turned out as refuse a ton of raw bones daily. Newark, New Jersey, has a population of 110,000, and sends six tons of bones daily, including heads and heels, from the butchers to a large bone-mill two miles distant. The bone-mills of our country are supplied from the large cities, and the bone refuse of 35,000,000 of rural and town population is lost to the soil. In the cities bones cost $25 to $30 per ton. A good plan for a farmer wishing to obtain pure bone meal at a cheap rate is to contract with butchers, farmers, and hotel-keepers for supplies of raw bones, which should first be boiled for

grease in a tank erected for the purpose. When taken from the tank the bones should be sorted, and the clean, firm shins of oxen and cows be sold at a good price—say $80 per ton—for the purposes of brush and button makers. The thin bones can be crushed to bone meal (or coarsely-ground bone) in a mill costing not more than a common bark-mill; and this coarsely-ground material can be made quite fine by sulphuric acid and water. The grease and choice bones will nearly repay the outlay for the mixed bones, and the cost of the manure will be substantially that of the acid, added to the expense of labor in boiling and grinding. Before commencing operations, however, it would be well for the operator to examine the working of some large bone-mill. In making bone meal, the bones are crushed by iron teeth or prongs arranged as in a bark-mill, and are then run through finer teeth. The production of bone flour involves a large expense. In this case two broad wheels, faced with the hardest ridged steel, revolve in opposite directions, and a stream of bone meal passes between the points of nearest contact. If the bones were put between flat stones revolving as in flour mills, sufficient grease and glue would be eliminated to fill the grooves, and the faces would slip.

Leached ashes.—At a meeting of the Western New York Farmers' Club, Mr. Quinby stated that he had used over ten thousand bushels of leached ashes in the last three years, and had found them good for all crops on a sandy or chestnut loam, and that he would cover his whole farm with them if he could get them. When put in the hill they started corn early and vigorously; and when applied to wheat, at the rate of two to three hundred bushels per acre, they had increased the crop 100 per cent. They also proved to be an excellent fertilizer for clover. Mr. Collins stated that he had put leached ashes an inch deep on four acres of heavy clay land, and had obtained a fine crop of corn. The clay was rendered more friable and mellow.

Marl in Mississippi.—Mr. J. P. Steele, of Savannah, Tennessee, states that thousands of acres of land in Mississippi, lying on or near the Mobile and Ohio Railroad, underlaid with excellent shell marl, cropping out in the valleys, and only three to six feet below the surface of the ridges, can be bought for $5 to $10 an acre. A large portion of Northern and Central Mississippi is underlaid with this marl.

The menhaden fisheries of Long Island.—Menhaden come in vast shoals in the spring of the year, into the bays at the east end of Long Island, for the purpose of spawning. At that stage, however, they are generally in poor condition, and yield but little oil. They are not caught for food, but to be rendered into oil and manure. The number taken during the season of 1869 is estimated at 67,500,000. In addition, the shore seines and pounds took 5,500,000, of which more than one-half were sold to farmers, to be applied to the land for manure, while the remainder were taken to factories to be pressed for oil. The business of extracting the oil from the menhaden was commenced with the establishment of one factory, about twenty years ago. During the season of 1869 there were seventeen factories in operation, for a larger or smaller part of the time, on the shores of the Peconic and Gardiner's Bay. The capital invested in these factories, with the boats, nets, &c., is about half a million of dollars. Similar factories have been established in Maine, Rhode Island, Connecticut, New Jersey, and Virginia. During the same season there were over thirty gangs of men, three boats to a gang, out in Peconic Bay, one of which made a catch of 5,000,000 fish; the smallest catch was 500,000; the average, 2,500,000. For a period of seven months, over one hundred vessels and upwards of

three hundred men were employed in the bays. The oil extracted from the fish is used for various purposes; in dressing leather, in rope-walks, in painting, mixing with other oils, &c. The scrap is used as manure. Last season the product was 7,105 tons of manure, and 11,460 barrels of oil.

Loss from exposure of manure.—Dr. Nichols, of the Boston Journal of Chemistry, states that analyses made of manure taken from a water-soaked heap, and a similar quantity taken from the barn cellar, showed that the former possessed less than one-half of the money-value of the sheltered manure.

Variation in the quality of guano.—In thirteen samples of Guanape Island guano, reported on by the British Board of Trade, the proportion of ammonia varied from 3.8 per cent. to 18.8 per cent. Farmers should carefully investigate the quality of the guano offered, before purchasing.

Artificial fertilizers in Germany.—Mr. W. O. Atwater, in an account of a visit to one of the principal agricultural regions of North Germany, states that wherever he went he heard complaints of the adulteration of artificial fertilizers, and of the immense amount of poor material palmed off on farmers. German as well as English and French agricultural journals are full of such complaints. At the agricultural experiment stations distributed throughout Germany, and supported partly by the government, and partly by agricultural societies, it is one of the duties of the chemists there employed to examine fertilizers. Farmers buy of dealers, who warrant the fertilizers to contain a certain percentage of nitrogen, of soluble and insoluble phosphoric acid, of potash, &c. Samples are sent to the experimental stations, and there analyzed, generally free of cost. If the fertilizer falls below the standard, the dealer must make proper satisfaction to the farmer. By this method of test, an efficient check is put upon fraudulent dealing in fertilizers in the surrounding regions.

FRUITS AND VEGETABLES.

Fruit on the Illinois Central Railroad.—Mr. Joseph F. Tucker, general freight agent of the Illinois Central Railroad, informs the Department that there were received in Chicago, over that road, during the continuance of the strawberry season, from May 23 to June 9, 1870, 989,476 pounds of strawberries; nearly 500 tons. The two days of largest receipt were May 28 and 30; eight car loads, or 101,571 pounds, being received on the former day, and nine car loads, or 115,830 pounds, on the latter. In 1869 the fruit business on the Illinois Central Railroad, from Centralia and stations south of that place, to Chicago, amounted, in a season of fifty-five days, to over 2,500 tons.

Strawberries in Maine.—Mr. Israel Bemis, of Levant, Maine, during the season of 1869, raised, on twenty square rods of ground, 590 quarts of Wilson strawberries, which were sold at 21 cents per quart, amounting to $123 90.

Raspberries in Western New York.—Mr. P. C. Reynolds, of Rochester, New York, residing four miles from Lake Ontario, states that a neighbor had two acres, from which he picked 9,500 quarts of Franconia raspberries. The fruit was sold in Rochester, and amounted to $750 per acre. Had it been shipped to New York, the receipts would have been doubled. The Franconia raspberry in that locality gave a much larger yield than that of the Hudson River Antwerp.

Blackberries in Georgia.—Mr. J. Van Buren, of Clarksville, Georgia, says:

The blackberry here is one of the greatest pests we have to encounter in the cultivation of our crops; it causes more trouble and labor than the vilest weed that ever grew. The fruit grows very large, and there seem to be two or three varieties. Any quantity may be had from 75 cents to $1 per bushel, and sometimes for less. I have known them to be hauled by the wagon-load to distilleries, and distilled into brandy or other liquors.

Banana culture.—The cultivation of the banana is engaging considerable attention in the neighborhood of Pilatka, Florida, and the river counties. It is stated that three years ago a gentleman in Orange County set out nine plants, and is now reaping the fruits of a three-acre field, and realizes $125 per month from the fruit and the young plants that are continually suckering around the roots of the old plants. The banana fruits in all seasons, the year round, and is enriched by the shedding of its huge leaves.

Cranberries in the Pacific States.—It is stated that quite an impetus has been given to the sale of marsh lands in Washington Territory recently by the advent of a New Jersey cranberry-grower in quest of these valuable lands. The Oregon Statesman says there is a large marsh near Gray's Harbor, in that State, which is already covered with cranberry bushes growing wild, and yielding considerable fruit, which is picked and sold by the Indians. This marsh has been purchased of the Government by several gentlemen of Salem, New Jersey.

The plum curculio.—Dr. Hull, of Alton, Illinois, concludes, from his experience, that the curculio discovers its food by scent, and that when the temperature has reached a certain height it flies against the wind to the spot where it is found. At a temperature of 70° or less it is unable to fly, and is comparatively inactive at a temperature of 80°, and may be easily jarred down on sheets. When the temperature has risen to 85° the curculio flies so freely, especially in the sunshine, that where the trees are in the vicinity of infested and neglected orchards jarring becomes ineffective, the curculios coming in great numbers from these neighboring orchards. Dr. Hull says that in localities infested by the curculio, where contiguous orchards in considerable numbers occur, no general success need again be looked for until a scarcity of fruit reduces the curculios, or the proprietors of orchards unite to destroy them. Where it is only necessary to contend with curculios bred on the fruit-grower's own grounds, the process of destruction is easy, with the proper facilities for jarring. In the comparatively warm latitude of Alton hogs afford but a partial protection, and poultry scarcely any.

Potatoes in the Isle of Jersey.—The Journal of the Royal Agricultural Society of England for 1870 includes a prize essay, by C. P. Le Cornu, on the history of potato culture in the island of Jersey. For a long course of years the potato has been a leading crop in the island. In 1812 a full average crop was estimated at 36,000 pounds, Jersey weight, per acre—equivalent to 646⅔ bushels, of 60 pounds each. Potatoes intended for seed are dug before the stalks are entirely dry, and are hardened by exposure to air and sun, being occasionally turned during this process, after which they are packed away singly in layers on wooden floors, the principle of treatment being that of checking early sprouting and keeping the seed in its utmost vigor. The preparation of the seed is deemed of prime importance, and contributes very greatly to the earliness of the crop. Careful attention is paid to the selection of the soil, and its proper preparation, by plowing, manuring, &c. After plowing and harrowing it is customary to spread well-made stable manure at the

rate of about 22½ tons per acre. The use of sea-weed has been relinquished generally, and guano is employed with great advantage as an auxiliary to the stable manure. Planting is done in January and February, in drill-rows. As soon as the plants appear above ground, the soil between the rows is well loosened, and if frost does not interfere the crop grows quickly; so that about the last of April the first installment is forwarded to the London Market, the business rapidly increasing through the following month. A day is frequently of great importance to the pecuniary value of the consignment, and the producers are regularly informed by telegraph as to the state of the London market. The practice is to follow this crop of potatoes with one of roots, the heavy manuring of the former supplying an excellent nourishment for the latter crop.

LIVE STOCK.

Fat steers.—Mr. George Ayrault, of Poughkeepsie, New York, reports to the Department on four steers, seven-eighths Short-horn, raised by him, and sold near the close of 1869 to William Lalor, of Center Market, New York City, for $3,200, the age of one of the animals being seven years, and of the others six years. The largest stood about six feet high, with a girth of ten feet, and the weight of the animals was 3,300 pounds, 3,320 pounds, 3,406 pounds, and 3,440 pounds, respectively; their proportions being good, notwithstanding their enormous size. The aggregate gain in weight during the season of 1869 was 1,460 pounds. The net beef weight of the larger pair after slaughter was 4,537 pounds. Their average weight at the age of three years was 1,850 pounds. After attaining this age, each received daily a peck of corn-meal and wheat shorts, or oatmeal, combined, divided into two feeds, and, as dessert, a peck of sugar-beets twice a day. In the summer, until lately, their only feed was grass, supplemented with a little sweet hay. The second winter the daily feed of meal was increased to ten quarts each, given in two feeds. In the summer of 1869 each received one peck of meal per day, given at morning and at night; and in the winter following, twelve quarts of meal daily, in three feeds, besides roots. In the course of feeding they have had, in winter, the best of early-cut hay from old meadows, and have usually had access to it in summer. They were not closely confined in winter, usually having the run of a small yard, with access to water, and with sheds under which they could lie protected from storms, and were tied at feeding time.

It is Mr. Ayrault's opinion that when cattle are fattening, and it is desired to give them all the grain they will eat without being clogged, it is important to feed three times a day; and he considers beets, or their equivalent, essential in winter in promoting the growth of grain-fed cattle. He does not advise heavy feeding for beef until animals are well grown, his practice being to maintain his stock in merely thrifty condition until they reach the age of three years.

A committee of the Farmer's Club, American Institute, reporting on these cattle, state that they find that the only profit arising from the last year's growth of the animals was in the increased or "fancy" rates obtained on account of magnitude, and that, in Mr. Ayrault's judgment, five years is the age at which fattened cattle will give the greatest profit to the feeder.

English prize steers.—The following table gives the weight, respectively, of eight first-prize steers recently exhibited at Islington, England, the weight at birth being deducted, thus showing the increase from the

time of birth. The ages of the animals ranged from two years and eight months to four years and one month:

Breed.	Age.	Increase from birth.	Increase per month.
	Months.	*Pounds.*	*Pounds.*
Devon	38¾	1,574	40
Hereford	38	1,902	50
Short-horn	38	2,207	58
Sussex	32	1,998	62
Devon	45	1,652	37
Hereford	49	2,134	43
Short-horn	47	2,274	48
Sussex	45	2,522	56

They were full fed on like descriptions of food.

South American cattle in England.—Alfred Fox, United States consul at Falmouth, England, in a letter to this Department, writes as follows:

A steamer has lately landed here, in fair condition, with a few exceptions, from Montevideo, one hundred and forty-two oxen, which cost about £4 per head on board at Montevideo; six cows which cost about £3 per head; five calves, which go with the cows; two hundred and ninety-seven sheep, which cost about 5s. per head; and six horses, which cost about £4 per head. About seventy oxen were killed on the voyage, owing, as was alleged, to injuries sustained by the rough manner in which they were put on board, to the length of the voyage, (forty-three days,) to the high temperature at Bahia, where the steamer called to repair machinery, and to the want of experience in the requirements on board in this, the first experiment.

Sales of stock.—The largest sale of Short-horns ever effected in this country occurred at Xenia, Greene County, Ohio, June 8, 1870, when the famous Oakland herd of Mr. Daniel McMillan was sold at auction. Nearly one thousand cattle-breeders, from all parts of the United States and from Canada, were in attendance. The number of cattle sold was seventy-one, (including four cows with calves,) producing an aggregate of $63,980, making an average of $901 12, or, including the four calves, seventy-five head, averaging $853. The largest prices received for single animals were, for a cow, calved in May, 1864, $3,800; a heifer, twenty months old, $3,650; and a cow, calved in 1862, $3,600. The private sales from this herd, within the preceding six months, amounted to $20,100, making the aggregate of $84,080 for the entire herd. There were also sold thirty-three Berkshire hogs, aggregating $1,008; and a Norman stallion at $3,100. Amount of sales of stock of all kinds, including cattle previously sold at private sale, $88,288.

The following is an abstract of sales of stock by Kentucky breeders, at their annual public sales during the last week of June of this year, the average price per animal of the various lots being given: At Mr. Alexander's sale, six thorough-bred mares averaged $227 50 each; eighteen thorough-bred colts, foaled 1869, averaged $471 38; twenty-four thorough-bred fillies, foaled 1869, $391; thirteen head of trotting stock, $317 31; twenty-seven Alderney cattle, $152 77. At Mr. F. P. Kinkead's sale, fourteen horses averaged $151 42; five bulls, $183 60; twelve cows, $363 33; three Alderneys, $218 33; thirty-one head of sheep, &c., $17 16; seven hogs, $44 28. At the sale of Mr. Jesse H. Talbutt, twenty-eight cows averaged $221 96; eight bulls, $244 37. At Mr. B. B. Groom's sale, seventy-three cows averaged $249 73; eighteen bulls, $185 28; ten head mixed, $83. At Mr. Lewis Hampton's sale, thirty-four cows and calves averaged $323 82; nine bulls, $255; three

cows, (miscellaneous,) $225. At Mr. Kinkead's sale the highest figures for single animals were as follows: Sorrel gelding, $280; a bull, $365; a cow, $1,000; Essex hog, $75. At Mr. Talbutt's sale a roan bull, calved in 1867, sold for $620, and a roan cow, calved in 1862, $580. At Mr. Groom's sale a cow calved in 1866 was sold for $1,120, and a bull calved in May, 1864, $1,015. At Mr. Hampton's sale the highest priced cow was $505; highest priced bull, calved in 1869, $500.

Forty-two auction sales of Short-horns were held in England, Scotland, and Ireland, in 1869, at which 1,585 head were sold at prices ranging from 3½ to 650 guineas. The average realized was £35 5*s.* each, showing but a slight variation from the average price obtained in 1868, when 1,423 were sold at an average of £35 7*s.* each.

The highest prices ever known to have been realized in England for Short-horns were obtained by Mr. Sheldon, of Geneva, New York, United States, for six Duchess, sold to Messrs. Wallcott & Campbell for the sum of 1,100 guineas each.

VALUE OF DIFFERENT FOODS.

In reply to an Illinois farmer, who inquires which is the cheapest feed for fattening sheep, corn at 60 cents per bushel, oats at 40 cents, No. 2 barley at 75 cents, oil-cake at $35 per ton, or bran at $15 per ton, Mr. J. Harris presents the following estimate for one ton of each description of food at the stated prices:

	Price per ton.	Value of manure.	Actual cost of food.
Bran	$15 00	$14 59	$0 41
Corn	21 50	6 65	14 85
Oil-cake	35 00	19 72	15 28
Oats	25 00	7 70	17 30
Barley	31 66	6 32	25 34

Mr. Harris thinks there is little difference in the nutritive values of corn, oil-cake, oats, and barley, and that (making no comparison as to bran) at the foregoing prices corn is practically cheaper for feeding purposes than any of the other three articles.

Grinding and cooking corn.—In the district agricultural convention at Urbana, Ohio, in February, 1870, several members estimated the gain in the feeding value of corn ground and cooked at 100 per cent. over that fed raw. Mr. A. B. Buttles, of Columbus, made the only exact statement of cost of grinding and cooking, saying that he could get his corn ground for 10 cents per bushel, and cooked for 3 cents per bushel.

PROFITABLE HOGS.

A farmer in Shelby County, Kentucky, it is stated, bought two hundred and ten hogs, and corn to feed them, for $3,563; fed and sold them, averaging 323 pounds, for $6,640, and refused $954 for one hundred and eleven shoats which he had raised from them. Another man and his son fed and sold seven hundred and ninety-two hogs, averaging 305 pounds, receiving $21,000, his outlay having been $9,000. The first case shows a total profit (including valuation of shoats) of $4,031, averaging $19 20 on each animal of the original stock; the second, a total profit of $12,000, averaging $15 15 on each animal.

Mr. William Magie, of Butler County, Ohio, has sold, this season, thirty-

eight hogs, averaging 528.87 pounds each, dressed weight. The average gross weight was 611 pounds. These hogs were twenty-one months old.

Mr. John Ferris, of Lawrence, New York, states that four nine-months' pigs were killed in that place in 1869, the dressed weight of which was 400 pounds, 401 pounds, 410 pounds, and 450 pounds, respectively. Another, eight months old, weighed, dressed, 405 pounds.

Mr. D. J. Packer, of Woodbury, New Jersey, who remarks that he resides in the village and is not a farmer, gives a statement showing the profit realized by him in raising four pigs, purchased January 18, 1869, and slaughtered December 11, 1869, having been penned during the entire period. Their age, when killed, was fifteen months and nineteen days. The gross receipts were:

1,963 pounds of pork, at $14 per hundred		$274 82
Price offered for the manure		40 00
Total value received		314 82
Expenses were as follows:		
Four pigs, at $15 each	$60 00	
Corn	2 00	
Mill feed	27 25	
Hog cheese, (chandler's scraps)	28 36	
Ground rye and corn	17 60	
Small sweet potatoes	9 00	
48 bushels of corn, ground	51 20	
Total cost		195 41
Showing a net profit of		119 41

Raising hogs in Colorado.—A Colorado farmer urges more attention to the raising of hogs in that Territory. He says bacon, hams, and shoulders have averaged there more than 30 cents per pound for years, and that grain, at an average of 2½ cents per pound, as it has been for two years past, can nowhere else find so good a market as in the pig-pen. His experience is in favor of using early spring pigs. He feeds them on milk and offal from the kitchen and garden until they outgrow the supply, when he adds bran and shorts to the milk, letting it sour. His pigs thrive wonderfully on this fare, much better than on corn alone or any other dry grain. He had many pigs that on December 1 would dress 180 pounds each; while pigs from the same litter, fed on dry grain at a mill, would not dress half as much. For about two weeks before killing he gives them all the corn they will eat.

THE DAIRY.

Dairy farming in Vermont.—Mr. Nahum Brigham, of Bakersfield, Vermont, reports to the Department that he commenced the dairy season of 1869, April 1, with three cows, the number gradually increasing, as they came in, to fifteen cows at the middle of May. From the first-mentioned date to the close of the season, December 1, he made sixty tubs, or 3,000 pounds of butter, which was sold at the rate of 45 cents per pound, amounting to $1,350. He raised ten calves, worth $100, and 1,000 pounds of pork, which he sold for $130; total, $1.580, not including supplies for the family. The cows were kept up till June 1, previous to which date they were fed on hay, Indian meal, and sour milk. From that time they received only pasture, until October 1, when they were again put up and fed in the same manner as in the spring. The total cost of the meal was $75. The cows were of "native" breed, and were raised by Mr. Brigham. Their ages ranged from six years to seventeen years, averaging eleven years.

A profitable cow.—In March, 1868, Mr. G. W. Wild, of Brighton, Massachusetts, bought a cow for $125. He fed her liberally, allowing four quarts of corn meal daily, and after milking her 568 days, (during which time she averaged ten quarts daily,) finding her in good condition for beef, slaughtered her, obtaining 805 pounds dressed weight. The rough tallow weighed 77 pounds. She was giving seven quarts daily at the time of slaughtering. The exhibit of debt and credit account stands thus:

Cr.		
By 5,680 quarts of milk, at 8 cents per quart		$454 40
By beef sold		116 00
Total receipts		570 40
Dr.		
To original cost	$125 00	
To keeping 568 days, at 40 cents per day	227 20	
Total		352 20
Net profit		218 20

This result shows a net profit of $140 22 per year.

A grade Short-horn.—Mr. S. P. Miller, of Fayetteville, Vermont, reports to the Department that he has a grade Short-horn cow, eleven years old in the summer of 1869, weighing about 1,100 pounds. From the milk of this cow he made, during the seven months from April 20, 1869, to November 19, 1869, 311 pounds of butter, and during the same period sold 142 quarts of new milk, besides supplying the milk and cream which were required for his family of five persons. The butter sold for 45 cents a pound, with the exception of that sold during the six weeks previous to June 1, which was marketed at a lower price. The cow received two quarts of corn meal and wheat middlings or shorts daily, besides hay and common pasture.

Butter from Jerseys.—The following exhibit is made of the profits from two thorough-bred Jersey cows belonging to a gentleman in Lewiston, Maine. The cows calved in the latter part of May, 1869. From their milk between June 15 and February 15, following, 504 pounds of butter were made, worth 50 cents per pound. The calves were sold at eight weeks of age for $16. The legitimate gross profits of the cows for the eight months are stated at $268. One of the cows calved again April 10, 1870, and the other in May.

Spaying for milk.—M. Vattemare, veterinary surgeon, reports that the spaying of cows at a proper age and period results in an increase of 33 per cent. in quantity of milk. Another expert testifies to similar results with twenty-seven cows, of ages ranging from six to fifteen years.

FARM MANAGEMENT.

An unprofitable harvest.—A farmer in Olmsted County, Minnesota, states that in 1869 he raised 9,000 bushels of wheat, and 2,000 bushels of oats, and was obliged to sell part of his stock to pay expenses. Notwithstanding abundant crops, wheat paid little more than the cost of harvesting.

A Southern example.—In Stewart County, Georgia, in 1869, a farmer, assisted only by his wife, who also attended to her domestic affairs, cultivated forty acres of land, making eleven bales of cotton, eight barrels

of sirup, and one hundred and fifty bushels of corn. He had at the opening of the year only a few bushels of corn, one mule, and no money; but he bought his family supplies on time, and paid for them after the sale of his crop. He also paid for the land he cultivated, at $15 per acre, out of the proceeds of his crop, and had means enough left to buy as much more.

Employment of farm machinery.—A farmer in Benton County, Oregon, in 1868, assisted by two boys under fifteen years of age, with two gang-plows, one header, an eight-horse thrasher, in which he held a half interest, and hired labor, costing less than $200, prepared the ground for, raised, and made ready for market 6,084 bushels of wheat, and 2,000 bushels of other grain. The outlay for hired labor was more than offset by the earnings of his header and thrasher in working for his neighbors.

Change in English methods of agriculture.—Twenty-five years ago, says an English agricultural writer, the only profitable practice of enriching lighter soils was by growing green crops and consuming them on the land, long rest in fallow being almost the only profitable method on the heavier soils. At the present day the best farm management includes the more energetic use of artificial means; the use of richer manures from purchased cattle foods; and especially the larger employment of purchased manures, both home-manufactured and imported; so that the fertility which was formerly obtained in two or three years under the best management is now accomplished with greater profit almost immediately.

MISCELLANEOUS.

Cotton-seed oil at Memphis, Tennessee.—During the year ending July 1, 1870, the Panola Oil and Fertilizer Company, of Memphis, Tennessee, manufactured 1,800 tons of oil cake, and 150,000 gallons of cotton-seed oil. The Memphis Oil Company manufactured about the same quantity, and the Bluff City Company about two-thirds as much. The Panola Company propose to convert their oil cake into a valuable fertilizer, by mixing with it bone-dust, plaster, salt, and ashes.

Loss in removal of cotton seed.—Professor Hilgard, of Mississippi, makes the suggestive statement that when the lint only of the cotton crop is removed from the land, it takes from it not more than four pounds of soil ingredients for each bale of cotton made; but when both lint and seed are permanently removed the land loses, on an average, forty-two pounds of soil ingredients for every bale. In the former case the cotton crop is one of the least exhaustive known; in the latter, one of the most exhaustive.

Cotton manufacturing in South Carolina.—The last annual report of the president of the Graniteville (South Carolina) Manufacturing Company states the production of the mill during the year as follows: 3,367,000 yards of 4-4 sheeting; 2,332,800 yards of 7-8 sheeting; 1,103,880 yards of 7-8 drilling; 1,839,600 yards of 3-4 shirting; total, 8,643,280 yards. About five hundred and fifty operatives are employed, nearly all of them natives of the South.

California cotton.—A scientific expert in cotton states that the cotton grown from Alabama seed in Merced County, California, this year, compares favorably with Brazilian and Egyptian cotton, and is superior to the best southern upland for spinning purposes. He asserts that the effect of the dry and equable climate of California is an improvement in the staple yielded from the same seed as planted upon southern uplands. There are large sections of the State well adapted to this culture.

Corn and cotton versus cotton.—A correspondent in Lee County, Geor-

gia, who employs sixty hands in cultivating his land, and who is also a merchant, furnishing supplies to about fifty neighboring planters, taking the products of their plantations in payment in the fall, writes that, notwithstanding the fact that the same land which grows 15 to 20 bushels of corn, worth $20 to $30, will produce 700 to 1,000 pounds of seed-cotton, worth $35 to $75, experience and observation convince him that the all-cotton system is unprofitable. His experience is that those who buy all their corn and meat never have any surplus money; those who buy all their meat and a portion of their corn have some money left, according to the proportion of the home supply of corn; those who raise all their corn, buying meat, do better still; while those who raise both corn and meat are most prosperous of all. In his judgment the explanation is, that a skillful manager can, at the same time, raise an ample supply of corn and nearly a full crop of cotton, doing the chief part of the work on the corn crop before beginning the harvest work on the cotton. It is a question of complete utilization of time on the one hand, and waste of time on the other.

Steam-plowing in Cuba.—A sugar-planter in Cuba writes that in November, 1868, he commenced work with one of the Fowler steam-plows, (running with two engines of fourteen-horse power each,) and since then has broken up 2,000 acres of strong clay land intermixed with stones of all sizes, and resting for the most part on a stone bottom, plowing to an average depth of eighteen inches. The plow having been managed by an experienced hand, the breakages have been few and of a trivial character, and the wire-rope is still in excellent condition. The lands of the estate have been doubled in value by steam-plowing, and what was formerly almost an impervious marsh, the effect partly of nature and partly of inefficient cultivation, has been reduced to a porous soil.

Harvesting wheat in California.—A California writer states that in his region wheat is often cut, thrashed, and put in sacks on the same day. The "header," which is now generally used instead of the reaper, cuts the straw midway, and makes a swath twice as wide as that made by the reaper. With two headers and five wagons a large thrashing-machine is kept running, and in this manner 1,500 bushels of wheat (or the crop of forty acres) are harvested in a single day.

A suggestive experiment.—One of the largest wheat-growers in California has avoided the expense of commission, tolls, storage, &c., by shipping his wheat direct to Liverpool. He chartered a ship, which was hauled in at the end of the Central Pacific Railroad wharf, at Oakland, and in a few hours 1,200 tons of grain were brought alongside and stowed, and the vessel returned to the stream, ready for her voyage, without having incurred any wharfage charges.

Preservation of hops.—By means of an air-tight "refrigerating chamber," recently invented, hops may be preserved for a long time without deterioration. A brewer of Albany, New York, states that he put twenty-four bales of New York hops in one of these chambers, February 15, 1869. They were examined several times during the ensuing summer, fall, and winter, without exhibiting any loss in quality. A portion of these hops used during the winter of 1869-'70 showed no change of color, and proved in every respect equal to the new crop.

Hops in Alabama.—Dr. E. H. Sholl, of Sumter County, Alabama, states that in February, 1868, he and Mr. E. Kring planted one and a half acre in hops, manuring liberally with home-made superphosphate. The vines grew vigorously, and were poled May 8. At date of June 3 some of the hops were fully matured, and the entire crop was gathered by July 20. In January, 1869, seven and a half acres were set out, and

there was promise of a large yield, but, owing to the impossibility of procuring pickers at the proper time, the enterprise was necessarily abandoned. Dr. S. is satisfied that, with a proper supply of labor, hops can be raised in that region very successfully, with a yield of 1,400 to 1,800 pounds per acre, and that the product can be put on the market from the 1st to the 10th of August, the crop being thus made especially valuable by early availability. He adds: "Good cotton land, in other words, a light sandy loam, with clay subsoil, is our best hop land."

Cost of raising corn.—At the Madison County (Illinois) Farmers' Convention, in January, 1870, Mr. J. C. Burroughs made the following statement of the cost of cultivating and husking twenty acres of corn, no allowance being made for manure:

First plowing, ten days, at $3 per day	$30 00
Second plowing, ten days, at $3 per day	30 00
Two days' harrowing, at $3 per day	6 00
One and one-half day marking off	4 50
One and one-half day checking off	4 50
Three bushels seed corn	2 00
Two droppers, two days, at $1 each	4 00
Three days harrowing and rolling after planting	9 00
Plowing five days, single team, at $2	10 00
Plowing four days, single team, at $2	8 00
Plowing four days, single team, at $2	8 00
Cultivating, three days	6 00
Cost of husking and cribbing	50 00
Interest on valuation of land, $7 50 per acre	150 00
Total	322 00

Taxes and cost of fencing are offset by the fodder produced. At these rates, taking the yield of corn at 60 bushels per acre, the cost, when cribbed, would be about 27 cents per bushel.

Rape culture in Wisconsin.—The rape plant is largely cultivated by German farmers in Fond du Lac and Calumet counties, Wisconsin. The quantity marketed at Fond du Lac in 1860 is stated at 4,000 bushels, and in 1866 at 20,000 bushels. Land under fair culture will yield ten to eighteen bushels of rape seed per acre, though thirty-five bushels per acre have been obtained. The price for a series of years has ranged from $2 to $2 50 per bushel. The seeds yield about two gallons of oil per bushel. The crop leaves the soil in excellent condition, and the chaff, when mixed with roots, makes an excellent cattle food. The rape-seed cake is highly valued in Europe for feeding dairy cows. Prices of ground cake this season have ranged from $16 to $20 per ton.

The cork tree in Mississippi.—A correspondent in Wayne County, Mississippi, planted some Spanish cork-oak acorns received from the Department, in the winter of 1859. They all came up, and the largest tree had, at the commencement of 1870, attained a height of about thirteen feet, the trunk being eleven inches in diameter, and the cork around the body more than an inch thick. His soil is poor, being sandy, with a clay subsoil, and, for this reason, unfavorable to the rapid growth of these trees.

A valuable tree.—In January, 1866, there was brought to New York from the West a black-walnut tree, seventy feet long, containing 4,600 feet, board measure, which, when cut into veneers, thirty to the inch, would be equal to 138,000 feet, worth, at 20 cents per foot, $27,600. The estimated cost of cutting, carting, and storing for sale was $700.

Utilizing the blue jay.—Charles Carlisle, of Woodstock, Vermont, states that he has found the blue jay a protection to his crops of small fruits,

and that, in order to encourage their presence in the summer, he has been in the habit of allowing free access to his corn-crib during the winter.

Solution for destroying insects.—Mr. Cloëz, of the garden of the Paris Museum, gives in the *Revue Horticole* an efficacious recipe for destroying plant-lice and other insects. Three and a half ounces quassia chips, and five drachms staves-acre seeds, in powder, are placed in seven pints of water and boiled down to five pints. When cooled, the strained liquid is ready for use, either in a watering-pot or syringe.

Feeding fish to stock in coast regions.—At the farmers' convention at Lewiston, Maine, in January, 1870, Mr. Warren, of Ellsworth, stated that he had fed "fish-chum" to his sheep and poultry, in the place of corn and turnips, for some time, and his experience was that it was worth as much per pound as corn. He gave two quarts of the "chum" to every dozen sheep. By a new method of preparation, all offensive odor had been removed from it, and cows and sheep consumed it eagerly. Secretary Goodale, of the State Board of Agriculture, said that he had had the feeding of sheep with refuse fish under his observation for ten years, and that it had proved very satisfactory. It was used to best advantage as a supplement to bog-hay and other inferior fodder, deficient in nitrogenous elements.

Tobacco in Ohio.—It is estimated that the tobacco crop of the Miami Valley this year will reach 12,000,000 pounds. The quality of the product is thought to nearly equal that of the Connecticut gold-leaf. A large portion has been sold at 17 cents per pound, at which rate the crop would realize $2,040,000. The average value of the crop per acre is over $200. Nearly three-fourths of the whole product was grown in Montgomery County.

Tobacco-growing in Massachusetts.—The estimated annual value of the tobacco crop of Hatfield, Massachusetts, is $275,000. The number of acres planted averages between 700 and 800, with an aggregate product of 1,100,000 pounds. Twenty years ago only about two acres were cultivated in tobacco.

The castor bean in Texas.—A gentleman who has had considerable practical acquaintance with the cultivation of the castor bean in Texas, writing in the spring of the present year, states, as an example of the perennial tendency of the plant in Southern Texas, that B. C. Franklin, of Galveston, had a plant in his garden the stem of which was seven inches in diameter, and that it had yielded seed for eight years. Captain Slaight, of Chapel Hill, relates a similar experience. Mr. McIntire, of Washington, reports having raised 70 bushels per acre, and E. Bell, of Gonzales, raised 100 bushels on one acre. The plant is quite obnoxious to insects, and its freedom from their ravages is a strong point in favor of its culture. The principal losses attending its cultivation in the extreme south arise from planting the small light-colored bean of Missouri and Illinois, instead of the large seed appropriate to the climate of Texas and Florida; from planting too thickly; and from mismanagement at harvesting. The writer estimates that in Southern Texas and Florida, on proper soil and under skillful management, the product of clean seed would average as high as 2,700 pounds per acre, worth, at current prices, $81.

Remedy for club-foot in cabbage.—Bainbridge Bishop, of New Russia, New York, states that he has found, by long experience, that club-foot in cabbage can be remedied by boiling leaves and twigs of the scarlet-berried elderberry to a strong decoction, and pouring a gill, cold, on the center of the plant. One application is generally sufficient. On heavy

soils it may be necessary to loosen the earth about the stem of each plant. As a preventive, water the plants once or twice with the decoction, after setting out. The application has also a good manurial effect.

Fifty years ago.—At the Farmers' Convention held at Lewiston, Maine, in January, 1870, Hon. Robert Martin, of Auburn, seventy years of age, said that "fifty years ago the farmer thought if he sold a two-year-old heifer for enough to buy a barrel of flour he was doing a good business. Now, a good two-year-old heifer sells for enough to buy four or five barrels of flour."

Seed-raising, &c., at Erfurt, Germany.—A recent visitor at Erfurt, Germany, states that he found 143 acres in and around the city devoted to the production of flower seeds, and 136 to that of vegetable seeds, the market being chiefly in the larger German cities. The amount of glass covering houses for the culture of exotic plants, and the hot and cold beds, is 250,000 square feet. More than 300,000 catalogues and price-lists are annually printed for the flower and vegetable trade; the number of wholesale catalogues being 50,000, of which about one-half are prepared for England and America. The making of linen and paper bags for seeds gives employment to many poor people in the surrounding villages, involving an estimated annual outlay of $7,000. Several small villages are sustained chiefly by the manufacture of flower-pots for the Erfurt trade, and about 600,000 of these are annually planted with 3,600,000 stock-gilly flowers of many varieties and colors—a specialty for which Erfurt has been celebrated since 1810.

RECENT FARM EXPERIMENTS.

WHEAT.

Fertilizers on wheat.—Mr. R. W. Pruitt, of Salem, Alabama, reports an experiment with wheat on two acres of common oak and hickory land, which had been in cultivation ten years, the last year in potatoes. At the time of experiment the land was not capable of producing more than seven or eight bushels of wheat per acre, without manure. In the latter part of November, 1869, the ground was broken up in the following manner: A furrow was opened to the depth of about four inches, with a turning plow, which was followed by a subsoil plow, running nearly eight inches deep; and the field was then cross-plowed with scooters, and laid off with a small scooter in furrows ten to twelve inches apart, leaving the surface in small ridges. December 3 he sowed broadcast 1¼ bushel of Clayton wheat, 30 bushels of cotton seed, and 140 pounds of Peruvian guano, per acre, and dragged the ground level and smooth with a good home-made brush. The wheat came up "in beautiful drills," and grew so rapidly that on the 1st of February he turned in his calves, and grazed it. The field ripened in the latter part of May, showing a solid mass of wheat about five and one-half feet high. Sixty-four bushels of excellent wheat were harvested from the two acres, and 11 to 16 bushels were lost by lodging, by ravages of birds, &c. Expenses: three plowings, $7 50; laying off, $1 25; 60 bushels of cotton seed, $10 80; 280 pounds guano, $17 50; hauling out and strewing seed and fertilizers, $3; cutting, binding, and thrashing, $10; total, $50 05. Receipts: 6 bushels wheat, $128; 6 loads of straw, $12; value of pasturage of calves, $5; total, $145, showing a profit of $47 47½ per acre, besides the improvement of the soil.

Mr. Samuel Bailey, of Maxey, Georgia, reports an experiment with fertilizers on wheat, on one acre of thin, exhausted land, which, in 1869, with the aid of manure, had produced 17 bushels of corn. Late in October, 1869, he broke up the land with a two-horse Brinley plow, and spread broadcast six two-horse loads of well-rotted stable manure, which he turned under by cross-plowing with the same plow. He then sowed broadcast 250 pounds of dissolved bone, harrowed, and seeded with 120 pounds of wheat, covering with a heavy brush. Early in February, the wheat being about six inches high, he top-dressed with 250 pounds of ammoniated phosphate. In the latter part of March, when the wheat was in the boot, he applied 125 pounds of ammoniated dissolved bone and 25 pounds of salt, ground together, the application being made on the dew in the morning, and repeated, in the same amount and manner, one week afterward. The product of the acre was 3,415 pounds of good wheat, or nearly 57 bushels. No estimate was made of the cost of the stable manure, but the cost of the artificial fertilizers employed amounted to $27 55.

Improvement by green manuring, &c.—Mr. F. Stephenson, of Gainesville, Georgia, reports the example of a farmer who, in 1865, set apart 10 acres of an old sedge field, turned it under in June, and sowed wheat in September, harvesting the next year 4 bushels per acre. When the land got a good growth of weeds, he again turned under, one inch deeper than before, and in September sowed wheat, making a crop of 9 bushels per acre. The next year he turned the green growth still deeper, and made 17 bushels per acre; and the following year, 1869, his crop was 27 bushels per acre.

Superphosphate on wheat.—A farmer in Peacham, Vermont, reports that in October, 1866, he plowed to the depth of ten inches a pasture containing about 2¾ acres, the soil being a brown loam of uniform quality. The next year he planted potatoes, the field being dressed with 200 pounds of plaster; and in the ensuing spring he divided the land into three equal plots of 146 rods each. Plot 1 was sown with club wheat prepared by wetting with brine, and drying with Bradley's superphosphate. After harrowing once, a dressing of this fertilizer was applied, the rate per acre (including amount used with the seed) being 1,939 pounds, and the ground was then thoroughly harrowed and rolled. The other plots were treated in the same manner, except that plot 2 was fertilized with Paddock and Dean's raw bone, and plot 3 with Bradley's raw bone. The following table shows amounts of fertilizers applied and products obtained, calculated per acre:

Plot.	Manures applied.	Amount of manure per acre.	Product per acre.	Weight per bushel.
		Pounds.	*Bushels.*	*Pounds.*
1	Bradley's superphosphate	1,939	31.8	61
2	Paddock & Dean's raw bone	1,579	26.3	60
3	Bradley's raw bone	1,940	32.3	60

The excess of product on Nos. 1 and 3 over that on No. 2 paid for the excess of fertilizer used on those two plots. An analysis of the results from these expensive applications of manure shows that, whatever benefit might inure to a subsequent crop, the immediate returns were un-

remunerative. For instance, the application of Bradley's superphosphate, at 3½ cents per pound, would amount to $67 87 per acre, while the product obtained, rated at $2 26 per bushel, the average price in Vermont for that season, would amount to $71 87, returning only $4 over the cost of the fertilizer alone.

New Jersey Agricultural College experiments.—Experiments made on the experimental farm of the New Jersey Agricultural College, in 1869, exhibit the comparative effects of superphosphate of lime, bone-dust, and horn-dust, (the latter containing a large percentage of ammoniacal elements, and no phosphoric acid,) applied to wheat on a very poor and sour clay loam, which had been recently under-drained, and had received a light dressing of gas lime worked through the soil. The bone-dust showed the least effect; while the superphosphate gave the best return, the plot on which it was applied showing the greatest evenness of growth, and the earliest maturity, and greatest amount of product. The grain on all the plots was much damaged by rust.

English experiments with wheat and barley.—The journal of the Royal Agricultural Society of England for 1870 contains a report of experiments made in 1868 and 1869, in drilling wheat in rows of extraordinary distances—eighteen inches apart. The experiments of 1868 were made on the experimental farm of the Royal Agricultural College. The experiments of 1869 were instituted by members of the Cirencester Chamber of Agriculture, in accordance with a uniform plan mutually agreed upon, the agricultural college being auxiliary to the scheme. The trial lay between rows drilled at the usual distance apart, (nine inches,) and rows eighteen inches apart, or two rows nine inches apart alternating with spaces of twenty-seven inches. The following summary exhibits names of experimenters, and indicates the condition of the soils experimented on:

Earl Bathurst: The land in good agricultural condition, "a free working" soil, previously under clover and rye grass. The wheat of the more widely spaced plots maintained a dark green color and vigorous appearance up to harvest time, although the straw was not so clean and bright as in the other plots. Contrary to expectation, the yield also fell short of that of the plots of ordinary spaces, the widely spaced rows averaging about 29 bushels of 60 pounds each per acre, the others about 32 bushels per acre. Royal Agricultural College: The land was in poor condition, and had been in barley the previous summer. The average yield of the rows of ordinary spacing was 25½ bushels, and, notwithstanding the saving of seed, the exhibit of the widely spaced rows showed no advantage in deviating from the usual distances. W. Smith, of Bibury: The land was in excellent condition and of superior productiveness, well prepared for wheat, "a quick free barley soil," dark in color. Here, there was a marked increase in yield on the widely spaced rows, and the heads were exceedingly large. In one plot where two rows, nine inches apart, alternated with spaces of twenty-seven inches, the soil being firmly pressed with the foot, there was an increase of 8½ bushels of grain and 880 pounds of straw per acre, over the product of the plot of ordinary spaces, which yielded 46 bushels of wheat per acre. In another plot, where two rows nine inches apart were alternated with spaces of twenty-seven inches, which were planted with potatoes, and consequently worked to some extent, there was an increase of 7½ bushels of grain and 760 pounds of straw per acre. Thus, the land of best condition and highest productiveness gave a very favorable exhibit even on an extremely wide spacing of rows. Another point embraced in these experimental trials on wheat had reference to methods of cultivation, and the results bearing on this point indicated the impropriety of deep

cultivation between the wheat rows at an advanced period of the season.

Experiments made with barley on the same fields, and under the same conditions that were employed in the trials with wheat, gave results decidedly favorable to wide distances between rows and comparatively deep interculture. Another experiment on barley by Mr. Iles, of Kempsford, gave like results, and in this case, although the wide drilled plots did not appear to advantage in early summer, at harvest the ears were superior, and a larger weight of grain was obtained than on the plots of ordinary spaces. Besides the advantage of larger product was that of a saving of seed and of greater facility in working the crop.

Concerted experiments were also made in the application of superphosphate and nitrate of soda on wheat, certain plots receiving only one of these fertilizers, others receiving the two combined. The trials also included winter top-dressings in contrast with those made in spring. As to the application of nitrate of soda alone, results favored a dressing of 168 pounds per acre, with a probability that heavier dressings might be advantageously used. An experiment made by Mr. Ruck, of Braydon, on stiff land, sustained the exhibit of former experience, namely, that clay land does not respond to applications of nitrate of soda so readily as land of lighter character. The results of the various experiments are reduced to a money valuation, in which the cost of the nitrate of soda is put at 16*s.* per cwt. of 112 pounds, and the value of the wheat at 6*s.* per bushel, (calculated in this series at 62 pounds.) The increase of grain resulting from each hundred pounds of the fertilizer applied is stated as follows: Earl Bathurst, for an expenditure of 14*s.* $3\frac{1}{4}$*d.*, obtained $3\frac{1}{2}$ bushels of wheat, worth 21*s.*; or a profit of 6*s.* $8\frac{3}{4}$*d.* on 100 pounds of nitrate of soda. The college farm obtained an increase of 4 bushels of wheat, worth 24*s.*; Mr. Smith, an increase of $4\frac{1}{2}$ bushels, worth 27*s.*; Mr. Ruck, an increase of $3\frac{1}{6}$ bushels, worth 19*s.* In these cases, respectively, the products of unmanured portions were as follows: $31\frac{4}{5}$ bushels per acre, $24\frac{1}{2}$ bushels, $44\frac{1}{2}$ bushels, 35 bushels—a significant exhibit of the productiveness of the various soils at the time of experiment. A satisfactory result was obtained on the highly productive soil of Mr. Smith by adding superphosphate, at the rate of 3 cwt. per acre, to the nitrate of soda. Each 100 pounds of superphosphate, used in combination at a cost of $5\frac{1}{4}$*s.*, are credited with an increase worth 12*s.* In the other cases the addition of superphosphate was not remunerative. As between spring and winter dressing of these fertilizers, the general tenor of the experiments favored the former.

CORN.

One hundred and twenty-seven bushels per acre.—Mr. David H. Bronson, of Guthrieville, Pennsylvania, in the fall of 1869 and the ensuing spring, applied broadcast, on 25 acres of clover and timothy sward, 100 wagon-loads of unleached livery stable and barn-yard manure, 50 loads of which had been hauled a distance of three miles. Besides this dressing, the land was liberally limed. On four acres of this field he also applied hog pen manure, at the rate of three ox-cart loads per acre, and, after plowing and thoroughly pulverizing the soil, marked rows three and a half feet apart, with hills at distances of fifteen to eighteen inches. He planted May 10th, each hill receiving a handful of hen-manure, plaster and ashes, mixed in equal proportions, and two grains of corn. The four acres averaged $127\frac{1}{2}$ bushels of shelled corn per acre, the height of the stalks varying from thirteen to sixteen feet, many measuring seven inches in circumference. From personal experience and observation,

Mr. Bronson urges the necessity of sheltering barn-yard manure from sun and rain, and the propriety of utilizing fully the manurial resources of the farmer's own neighborhood before resorting to commercial fertilizers.

One hundred and five bushels per acre.—Dr. Nichols, of the Boston Journal of Chemistry, states the following experiment in raising corn on green sward, turned over in the fall of 1868: In the spring barn-yard manure was spread on the furrows at the rate of four cords per acre, and harrowed in, and the soil finely pulverized with a Geddes harrow. Hills were marked three feet apart, and a handful of his "bone and ashes mixture" (see Report for 1869, p. 431.) was placed in each, a slight covering of earth being then drawn over, and five kernels of corn dropped upon it. The growth of the field was so luxuriant that it was cultivated but once after planting. The stalks bore two or three ears each, many of them fourteen inches long, and the kernels were large and full, and of a brilliant yellow. The product was 105 bushels of shelled corn per acre. This success is attributed to fall plowing, thorough pulverization of the soil in the spring, manure in which was preserved the liquid excrement of the animal, the application of this manure to the surface of the soil, and the use of the bone and ash mixture in the hills. Charging the corn crop with one-half of the cost of the fertilizers employed, the cost of the corn was 45 cents per bushel. The market value of the quality grown was $1 25 per bushel, leaving a profit of 80 cents per bushel, or $84 per acre, besides the value of the fodder.

Two hundred bushels per acre.—In the proceedings of the annual convention of the South Carolina Agricultural and Mechanical Society for 1869 is a report by Mr. J. W. Parker of experiments in growing corn, of which the following is an abstract: Selection was made of a quagmire grown over with rushes, willows, and sour grass, abounding with snakes and malaria, and traversed by a winding, sluggish stream. Thorough drainage was attained by the construction of a canal and underdrains, and during the summer the land was cleared, leveled, and broken up with a two-horse plow. In November a heavy coat of cow-house manure was applied and plowed under, and the process was repeated in January, and again in March, with subsoiling. In April, the weeds, having attained a luxuriant growth, were limed and turned under; in May another coat of manure was plowed under, and the land was harrowed perfectly level and laid off in rows three feet apart. In the furrows were applied Peruvian guano, salt, and plaster, at the rate of 200 pounds of each per acre. The seed corn, having been soaked in a solution of niter and rolled in plaster, was dropped ten inches apart in the rows, and covered with rakes, after which the land was rolled. The corn was up in five days from planting, and, as soon as it was sufficiently large, a long, narrow plow was run around it, followed by the hoe, the crop being kept clean by shallow, level culture until it began to shoot and tassel. The field was then irrigated by conveying from a reservoir a gentle flow of water through every alternate row. The yield on two acres was 147 bushels per acre. The following year the experiment was repeated in like manner, except that the rows were laid off two and one-half feet apart. One acre yielded 200¾ bushels, as attested by a viewing committee. Mr. Parker received premiums on these crops from the society named. He attributes much to irrigation in these instances of extraordinary product, and concludes from these and former experiments that success in corn-growing depends greatly on thorough preparation of the soil during fall and winter by deep plowing, with under-draining of moist lands, this preparation to be followed by judi-

cious manuring. While the early working of the field should be deep, the latter culture should be shallow, and the roots of the corn should not be disturbed after it begins to tassel.

Fertilizers on corn.—A field which had been mowed for two years was divided into plots, each of which measured two-fifths of an acre, and contained ten rows extending across the field. The soil was a gravelly loam, and the cultivation was equal. The season was very wet and cold, however, and the ground was so moist as to prevent proper cultivation. Plot 1 received no manure; the other plots received, in December, eight two-horse loads of well-rotted barn-yard manure per acre. Plots 3 to 8, in addition to this, received other fertilizers, as follows: Plot 3, poudrette, made by composting night-soil with four times its bulk of swamp-muck. The corn having been dropped, one quart of the compost was deposited on the corn, and covered with two or three hoefuls of earth. Plot 4, a small shovelful of a compost (one year old) of one-third manure and two-thirds muck was applied to each hill in the same manner as fertilizer No. 3. Plot 5, a purchased fertilizer, bearing the name of superphosphate, but apparently almost entirely composed of the flesh of dead animals, was dropped on the bottom of the hill and then covered with earth, on which the corn was planted. Plot 6, ashes were dropped and covered with earth, on which the corn was planted. The ashes apparently destroyed the effect of the manure applied in December. Plot 7, a home-made superphosphate, composed of burnt bones pulverized as finely as possible, and dissolved with diluted sulphuric acid, in the proportion, by weight, of sixteen parts of burnt bone to seven parts of sulphuric acid, diluted with seven parts of water, was applied at the rate of 125 pounds per acre, at a cost of $5, the corn and superphosphate being dropped together in the hill. Plot 8, horn-dust from a comb-factory was applied in the same manner as the fertilizer of plot 7. The stalks grown on plots 3 and 7 were in each case about twice the quantity grown on plot 2, and on plot 4 half as many more as on plot 2. The corn on plots 3, 4, and 7 was harvested September 28, in ripe condition; that on the other plots was gathered October 13, in an unripe state. The sound corn obtained from plots 1 and 5 was not of the first quality. The yield of the various plots was as follows:

Plot 1, 35 bushels sound corn, and 17½ bushels soft corn per acre.
Plot 2, 57½ bushels sound corn, and 12½ bushels soft corn per acre.
Plot 3, 85 bushels sound corn, and 5 bushels soft corn per acre.
Plot 4, 68¾ bushels sound corn, and 10 bushels soft corn per acre.
Plot 5, 23¾ bushels sound corn, and 15⅝ bushels soft corn per acre.
Plot 6, 35 bushels sound corn, and 12½ bushels soft corn per acre.
Plot 7, 80 bushels sound corn, and 7½ bushels soft corn per acre.
Plot 8, 26¼ bushels sound corn, and 23¾ bushels soft corn per acre.

Mr. S. C. Pattee, of Warner, New Hampshire, reports an experiment made in 1869, on a ridge of dry land of uniform character, which had been mowed four years, yielding about one ton of hay to the acre in 1868. Of the fertilizers reported upon, the hen-manure compost was made of equal parts of hen-manure and rich loam, the latter of which had received the wash of the barn-yard. "My phosphate" was composed of bone-flour, treated with sulphuric acid in the proportion of sixteen pounds of the former to six pounds of the latter, dried, with ten pounds of plaster. The "bone-flour and ashes" were in equal parts, mixed according to the method of Dr. Nichols. The corn was planted in hills three and a half feet each way, and the experimental plots contained one-twentieth of an acre each, excepting the plot receiving no manure, which contained one-fortieth of an acre. The table exhibits the fertilizers applied

and the results obtained; being arranged in the order of largest product:

Nos.	Fertilizers.	Amount of manure per acre.	Product per acre.	Increase over unmanured plot.
		Pounds.	*Bushels.*	*Bushels.*
1	E. F. Coe's superphosphate	400	34	24
2	Croasdale superphosphate	400	33⅜	23⅜
3	Hen-manure compost	60 bushels	32½	22½
4	My phosphate	400	31¼	21¼
5	Bradley's superphosphate	400	30	20
6	Glasgow Co.'s ammoniated guano	400	29	19
7	Wilson's ammoniated superphosphate	400	25	15
8	Bone-flour and ashes	600	23¼	13¼
9	Lobster chum	800	18¼	8¼
10	No manure		10	

E. F. Coe's superphosphate, applied at a cost of $12 per acre, returned an increase of 24 bushels of corn per acre, worth $30, while the hen-droppings used in the composition of No. 2, at a cost of $22 50 per acre, (their local value being 75 cents per bushel,) returned an increase of 22½ bushels of corn per acre, worth $28 12½.

Westminster Farmers' Club reports.—Mr. John McNeil, of the Westminster (Vermont) Farmers' Club, reports that on pine plain land, which had been mowed only once, he turned under twenty-one horse loads of manure to the acre, harrowed, and laid out four plots, each over one-thirteenth of an acre in area, containing four rows, three and one-half feet apart and fourteen rods long, the hills three feet apart in the rows, and planted with corn. The first plot received Bradley's superphosphate, at a cost of 98 cents, a tablespoonful being put in each hill, and thoroughly incorporated with the soil before planting. The second plot received Bowers's complete manure, at a cost of 98 cents; the third plot, ashes, at a cost of 40 cents. The fourth plot received no other fertilizer than the stable manure. Putting the average price of corn for the region and year at $1 40 per bushel, and rating the corn in ear at 70 pounds to the bushel, the following is a summary of the results on the immediate crop:

Plot.	Cost of artificial fertilizers per acre.	Product per acre.	Gain per acre over product of plot 4.	Value per acre of excess over plot 4.	Net profit per acre from application of artificial fertilizers.
		Bushels.	*Bushels.*		
1	$13 20	46.37	8.27	$11 58	*$1 62
2	13 20	64.84	26.74	37 44	24 24
3	5 39	59.07	20.97	29 36	23 97
4		38.10			

*Loss.

Mr. N. G. Pierce, of the same club, reports an experiment in planting corn on hill land of rather heavy texture, with clayey subsoil. To four rows twenty-eight pounds of Bradley's superphosphate were applied, at a cost of 98 cents, being thoroughly incorporated with the soil before dropping the corn; to the next four rows ashes were applied on the hill after planting, at the same expense; to the next four rows, hen-manure in the hill at the same expense—the quantity being nearly three bushels, at 25 cents per bushel. The next four rows received no fertilizer, and their product was 716 pounds of corn in the ear. Plot 1 yielded 1,113 pounds, showing a gain of 397 pounds over the unfertilized plot; plot 2 yielded 859 pounds, a gain of 143 pounds: plot 3 yielded 740 pounds, a gain of 24 pounds. Thus, on four rows the superphosphate should receive a credit of $7 94 as the legitimate net profit over the cost of application; the ashes a credit of $2 86; the hen-manure, even at the low rate of 25 cents per bushel, only paying the cost of application.

POTATOES.

Mr. S. C. Pattee, of Warner, New Hampshire, reports the following experiment with potatoes on a ridge of dry land plowed late in the fall, and thoroughly harrowed in the spring, the area occupied being 1¼ acre. Rows were laid out three and a half feet apart, by running a plow lightly, and the hills were marked a little more than two feet apart, and planted with potatoes cut to one or two eyes in a piece, two pieces in each hill. The hills received a compost prepared by mixing four bushels of leached ashes with one peck of lime slacked with a saturated solution of salt, and one peck of gypsum. The product of potatoes was 200 bushels, or 160 bushels per acre, worth 45 cents per bushel. Total expenses: breaking up in the fall, $7 50; harrowing, May 12, $2 55; planting, May 20, $7 75; cost of compost, $2 25; 8½ bushels seed potatoes, $4 25; cultivating, June 14, $1 50; June 24, 25, two hoeings, employing three to four laborers, making a total of fifty-one hours' work, $7 65; October 6 to 9, digging the crop, $14; interest on land, $8; total, $55 45, or $44 36 per acre, making the average cost per bushel 27¾ cents; value of the crop, $90. Net profit over all expenses, including interest on land, $34 55, or $27 64 per acre. The yield included 15 bushels of Early Rose, 12 of Early Goodrich, and 4 of Excelsior potatoes, which, if sold at regular market prices, would have considerably increased the profit. Mr. Pattee finds the most suitable soil for the potato to be a light yellow loam, elevated in situation, and possessing good drainage, either natural or artificial, so that no water will stand upon it in the wettest part of the season. All unfermented, nitrogenous manures should be avoided as far as possible; but, if necessarily used, they should be applied in the fall and plowed in, as they will be less liable to produce disease than when spread on the surface. Ashes in liberal quantity make a good fertilizer, and plaster is excellent on some soils. Superphosphate of lime has, in some instances, doubled his crop.

Potash, superphosphate, &c., on potatoes.—The following is an abstract of reports by Professor Voelcker, of England, of experiments during the years 1867–'69, bearing specially on the effects of potash salts applied alone, and in combination with phosphatic manures, for the potato crop. In 1867, at Carleton, Carlisle, an experiment was made on a very sandy, light soil, in poor agricultural condition, on plots measuring one-twentieth of an acre each. Some of the plots were left unmanured; others were manured with dung at the rate of 20 tons per acre; one with mineral superphosphate, at the rate of 4 cwt. per acre; one with crude potash salts at the same rate; one with common salt at the same

rate; one with mineral superphosphate and potash salts, 4 cwt. of each per acre; and one with mineral superphosphate and common salt, 4 cwt. of each per acre. The manures were mixed with twice their weight of finely powdered earth, and sown by hand during showery weather. The potatoes were planted April 23. The season was a dry one. The potatoes on the dunged plots made a rapid and luxuriant growth, while those receiving the artificial manures suffered much from drought, and manifested a stinted growth, especially those dressed with common salt, which exhibited an unhealthy, shriveled appearance. The manured plots produced about 74 bushels of potatoes per acre, (60 pounds to the bushel,) and the various manures gave the following amounts of increase per acre over the unmanured soil: The dung, 160½ bushels; the mineral superphosphate combined with potash salts, 68 bushels; the mineral superphosphate with common salt, 57 bushels; the mineral superphosphate alone, 15 bushels; the crude potash salts alone, 9½ bushels; the common salt alone, no increase. The comment made on these results is, that on light land, in a dry season, rotted dung produces an effect which cannot be expected from artificial manures, the former supplying a large amount of decomposed organic matter, which serves to absorb and retain moisture. Professor Voelcker remarks that very soluble saline manures are rather dangerous agents, and when common salt and potash salts are used they should be applied early in the spring, so as to be thoroughly washed into the soil.

Experiments were made the same year near Broseley, on similarly dressed plots, but on rich land, producing, without manure, 470½ bushels of potatoes per acre. Owing to the fertility of the soil, the 20 tons of dung per acre produced no increase, the product, on the contrary, falling short of that on the unmanured soil, as did also the product of the other manured plots, excepting where 400 pounds of mineral superphosphate were applied in combination with the same amount of potash salts, this application giving an increase of 66½ bushels per acre.

In 1868, experiments were made at Lord Wenlock's Menagerie farm, Escrick, near York, on a sandy loam, in good condition, yielding, without manure, 122½ bushels of potatoes per acre. The following fertilizers were applied: 1. Mineral superphosphate, 4 cwt.; crude potash salts and sulphate of ammonia, each 2 cwt.; 2. Rotted dung, 20 tons; 3. Mineral superphosphate and crude potash salts, each 4 cwt.; 4 Mineral superphosphate, 4 cwt.; crude potash salts and nitrate of soda, each 2 cwt.; 5. Peruvian guano, 4 cwt.; 6. Mineral superphosphate and common salt, each 4 cwt. The plots manured with the mineral superphosphate and common salt combined showed a weakly condition, and gave but a slight increase of product. The portion dressed with the combination of mineral superphosphate and potash salts manifested at an early period some injury from the effect of potash salts. The portion dressed with Peruvian guano at first looked very promising, but later in the season suffered much from drought, and final results illustrated the need of abundant rains to give this fertilizer its full action. The following is an exhibit of the increase of product per acre from the application of the various manures, stated in the preceding order: 1, 183¼ bushels; 2, 188 bushels; 3, 148¼ bushels; 4, 152¼ bushels; 5, 45½ bushels; 6, 17½ bushels. Thus No. 1, the mixture of 4 cwt. of mineral superphosphate with 2 cwt. of potash salts and 2 cwt. of sulphate of ammonia, proved to be "an excellent manure for potatoes on light soil," producing in this instance an effect equal to that of 20 tons of rotted dung. The effect is diminished when nitrate of soda is substituted for the sulphate of ammonia in this combination.

An experiment made near Carlisle in the same year, on a friable, deep sandy loam, well suited for potatoes and root crops in general, gave results substantially in accordance with those of the Menagerie farm. The unmanured plots yielded 214$\frac{2}{3}$ bushels of potatoes per acre. Experiments were made in 1869, at "The Lizards," in the county of Durham, in a region of the carboniferous formation, on a stiff clay loam of uniform character, producing without manure 245$\frac{1}{4}$ bushels of potatoes per acre. On this productive clay soil the various manurial applications produced comparatively small effect, excepting the rotted dung. Taking some of these applications separately, and comparing effects on this clay soil with those obtained on the lighter soils, the following points of difference are exhibited: On the stiff clay loam, the mixture of mineral superphosphate with potash salts and sulphate of ammonia was much less beneficial than on the light, sandy soil. On the latter the mixture was quite as efficient as a heavy dressing of dung; but on the clay soil the mixture gave an increase of only 60 bushels per acre, against an increase of 122$\frac{4}{5}$ bushels from the dung, the peculiarly beneficial effects of which were due, in a measure, to its mechanical action in lightening up the stiff soil. On this heavy land nitrate of soda more than equaled sulphate of ammonia in the combination with mineral superphosphate and potash salts. The application of common salt was even more prejudicial than on the lighter soils. Professor Voelcker indicates the desirability in future trials on clay soils of experiments with mineral superphosphate and potash salts applied separately and in combination.

Other experiments were also made in 1869 at the Escrick Park Home farm, on light land in good condition and very productive, the unmanured plots yielding 245$\frac{2}{3}$ bushels of potatoes, producing quite as largely as those of "The Lizards." The results were similar to those obtained on the Menagerie farm in 1868, although the effect of the Peruvian guano was better, owing to the more favorable season.

COTTON.

Mr. J. M. Crawford, of Richland County, South Carolina, reports his method of procedure in growing five acres of cotton, on which he obtained a premium from the State Agricultural and Mechanical Society. His land was an upland basin, surrounded by a gradually rising slope. By underdraining, manuring, and judicious cultivation, it has been brought into very fertile condition, although, when purchased, it was wet, and comparatively unproductive. Drains were made by cutting ditches two feet wide by three and a half feet deep, filling in, to the depth of twelve inches, with bricks or stones, afterward throwing straw and corn-stalks on these materials, to prevent earth from settling among them, and finally filling up with earth. In November, 1868, after gathering his corn, Mr. Crawford broke up the ground with a half-shovel plow six inches deep, following with a two-horse, bull-tongue plow fifteen inches long, widened at the point. The field was then allowed to remain till January, when it was harrowed with a large two-horse, iron-toothed harrow, completely pulverizing the soil, and leaving the ground clean and level. April 1 he plowed and harrowed again, and laid off rows four feet apart, in which he applied a fertilizer composed in the following proportions: Peruvian guano, 200 pounds per acre; plaster, 300 pounds; leached ashes, 500 pounds. He then bedded up, and commenced planting (April 27) Boyd's Prolific seed, in hills three feet apart in the row, covering with the hoe. The cotton came up well, and was thinned to one stalk in a hill. Two more plowings were then given, and another hoeing. In August the crop was again hoed, the cotton then

lapping in the rows. The thorough preparation of the land before plowing made the labor of cultivating the crops comparatively light. The five acres produced 12,510 pounds of cotton, averaging 2,502 pounds per acre. Cost of manure: Guano, $14; plaster, $14; ashes, $4; stable manure, $20; total, $82; averaging $16 40 per acre.

Mr. Crawford also reports that in March, 1869, on a field of one acre, he applied broadcast and plowed under eighty loads of manure, costing $20, and planted Boyd's Prolific seed, the land being of the same nature as that of the five acres above mentioned, and cultivated in the same manner. This acre produced 3,960 pounds of cotton. The excess of production on this one acre over the average of the five-acre field was 1,458 pounds; the excess of cost of manure applied, only $3 60 per acre.

Mr. M. C. M. Hammond, of Beach Island, South Carolina, reports an experiment made in 1869 with fertilizers on cotton on a gray soil, thin from long tillage, underlaid by a red clay subsoil. The ground was opened March 29, with a shovel plow running five or six inches deep, at intervals of three feet, in rows north and south, and the fertilizers were equally distributed in the furrow, at the rate of 307 pounds per acre, and bedded over with a Brinley plow. April 19 the beds were opened with a small bull-tongue, and the seed dropped, eight or ten together, at distances of fifteen inches apart, and covered with a board, a fine rain following at night. The cultivation was done with sweep and hoe, each used three times, the first working being on May 12, the last, July 30. The spring was cold, and unfavorable to growth. Heavy rain storms occurred June 1 and July 27; the interval between the two being, in general, one of intense heat; there was a similar heated term in August. The stand was defective. The following are the fertilizers applied, with their respective products of seed cotton per acre: Dickson Compound, product, 1,258 pounds; J. T. Gardiner's Manipulated, 1,278 pounds; Patapsco, 1,058 pounds; Baugh's Raw-bone, 1,012 pounds; Peruvian guano, 999 pounds; Wilcox & Gibbs's Manipulated, 988 pounds; "J——," 676 pounds; no fertilizer, 481 pounds. The small product of the latter shows the great exhaustion of the soil on which the experiment was tried.

Mr. J. W. Roberts, of Osyka, Mississippi, reports to the Department an experiment made this year in fertilizing cotton on about 1¼ acre of poor upland, not capable of producing without manure more than 500 pounds of seed cotton. The ground was plowed to a good depth, and was otherwise well prepared; was manured with 370 pounds of Pierce's superphosphate of lime, and planted with "Dickson" seed. The crop of seed cotton amounted to 1,300 pounds, making 433 pounds of baled cotton, which, after paying all expenses, gave a net profit of $49 52. According to this exhibit, the fertilizer should be credited with an increase of, at least, 800 pounds of seed cotton, on the area named.

Cotton on drained land.—A "young planter" at Eatonton, Georgia, states his experience with a half acre of land which he under-drained in the fall of 1868, and which before that had been wet in the driest seasons. He accomplished the drainage by digging a ditch four feet deep and three feet wide, across which he placed poles, six feet apart, sunk in the earth to within six inches of the bottom of the ditch, crossing these with other poles, then overlaying with brush and filling up with earth. Before March of the next year the land was dry enough to be plowed. He then broke it up, opened rows about seven feet apart, and applied Dickson's Compound at the rate of 390 pounds to the acre; planted early, and gathered from the half acre 1,599 pounds

of seed cotton. Later practice has led him to prefer the use of plank troughs for under-drains, somewhat in the fashion of an inverted V.

Fertilizers in drill, and drilled and broadcast.—Mr. Thomas B. West, of Thompson, Georgia, reports an experiment with fertilizers applied in drills, and partly in drills and partly broadcast, on a field which had been in pasture thirty-five to forty years. He broke the land with a two-horse turn-plow, running ten inches deep, and laid off six one-quarter acre plots, five of which he dressed with fertilizers, and planted cotton May 12. The fertilizers applied were Dickson's Compound; Peruvian guano, dissolved bones, and plaster, in equal parts; and bone flour. The following table shows the manner and cost of application, and the results obtained per acre:

Plot.	Fertilizers.	Cost of application in drills.	Cost of application broadcast.	Total cost of application.	Value of increase of product over No. 1.	Per cent. gain or loss on manure investments.
1	No manure	....	....	....	....	....
2	Dickson's Compound	$8 00	....	$8 00	$9 24	Gain, 15½
3	Dickson's Compound	16 00	....	16 00	14 00	Loss, 12½
4	Peruvian guano, dissolved bones, and plaster	8 00	$8 00	16 00	39 76	Gain, 148½
5	Peruvian guano, dissolved bones, and plaster	8 00	16 00	24 00	42 28	Gain, 76
6	Bone flour	8 00	16 00	24 00	16 80	Loss, 30

In regard to applications of these fertilizers in the drill, Mr. West concludes that an amount costing $8 to $12 is sufficient, and that any excess over this quantity would be more beneficially applied broadcast. These conclusions have been sustained by the results of his general cotton crop.

Fertilizing old red land.—Mr. J. D. Willis, of Union Church, Mississippi, reports that in 1868 he planted a piece of old red land in cotton, and with common culture and no manure made 300 pounds of seed cotton per acre. In February, 1869, he laid off rows four feet apart, by running a turning plow twice in the same furrow, throwing the dirt each way, following with a long scooter at the bottom of the furrow. In the same furrow he then strewed forty bushels of fresh cotton seed, and 100 pounds of salt per acre, afterward adding a large amount of compost prepared by rotting fresh cotton seed with six times its bulk of muck and scrapings of the wood-yard, put in alternate layers, one inch in thickness of cotton seed being covered with a layer of muck and scrapings six inches thick. The fertilizers were then covered by a turning plow run on each side of the furrow, followed by a scooter. The middles were broken out in May, the cotton being planted May 17. As soon as the cotton was ready for scraping, he barred off with the turning plow, and afterward worked over the cotton every ten or twelve days, cultivating to the depth of half an inch. The first bloom was on July 15, and the crop yielded 1,170 pounds of lint per acre.

Cotton on Bermuda grass land.—In 1869, Mr. R. W. Bonner, of Clinton, Georgia, employing small, short scooters, thoroughly broke up about nine acres of land which had been in Bermuda grass twenty-four years

without being disturbed. He applied in the drill 120 pounds of Peruvian guano to the acre, and obtained from the yield 9,376 pounds of seed cotton, or about 1,042 pounds per acre. At date of his report, February, 1870, very little live grass was left on the field, but large quantities of dry turf, and he was about to plant again in cotton with expectations of an increased product.

Oats as a preparatory for cotton.—Mr. E. M. Pendleton, of Sparta, Georgia, in recommending oats as a preparatory crop for cotton, states his own experience in illustration of his views. During the last season he made a crop of oats sufficient to last six mules four months, and the cotton seed employed as a fertilizer for the crop more than paid for itself by the increase of vegetable matter remaining in the soil. The same amount of corn and fodder made on the land would have cost four times as great an outlay, and the benefit of the cotton seed would not have reached beyond the crop for which it was applied. He adds that, under proper methods of culture, a good stand of oats could be assured, and the amount of humus practically created by this crop is quadruple that left by the corn crop. On his own farm he practices a rotation of small grain dressed with cotton seed one year, and cotton dressed with a nitrophosphate the next year, and by this course he constantly increases the productiveness of his land.

MISCELLANEOUS.

Experiments on mangolds.—The following table presents results of experiments made in 1869, under the direction of Professor Voelcker, in applying various fertilizers to mangolds on light land in good condition. Two localities are included in the report—Ivor Moor, near Uxbridge, and Escrick Park, near York, England. At Ivor Moor, the seed was sown April 27. The artificial manures were sown with ashes to secure their uniform distribution, and harrowed in. The roots were harvested November 2. At Escrick Park the mangolds were sown May 11, on a field which had been cropped in barley in 1868. The soil was of a light, sandy character, and though naturally poor was in good condition. The roots were harvested November 11. In both cases the experimental field was divided into eleven plots of one-twentieth of an acre each. Professor Voelcker remarks that in former years he had applied potash salts alone to a variety of crops, but had found that in most cases little benefit had resulted from these salts unsupported by other fertilizing agents; therefore they were not employed in these experiments. The table gives the amounts of manure applied, and the products obtained per acre:

	Manures applied.	Amount of manure per acre.	Ivor Moor, product per acre.			Escrick Park, product per acre.		
			Tons.	*Cwts.*	*Lbs.*	*Tons.*	*Cwts.*	*Lbs.*
1	No manure		21	15	0	22	10	0
2	Mineral superphosphate ...... cwt..	3	23	10	0	23	10	0
3	Mineral superphosphate ...... do...	3	25	0	0	29	5	0
	Potash salts ...... do...	2						
4	Mineral superphosphate ...... do...	3	25	10	0	26	0	0
	Peruvian guano ...... do...	1						
5	Peruvian guano ...... do...	3	28	0	0	24	15	0
6	No manure	......	23	0	0	21	0	0

	Manures applied.	Amount of manure per acre.	Ivor Moor, product per acre. Tons.	Cwts.	Lbs.	Escrick Park, product per acre. Tons.	Cwts.	Lbs.
7	Mineral superphosphate ......cwt..	3	30	10	80	30	5	0
	Potash salts..................do...	2						
	Sulphate of ammonia.........do...	1						
8	Rotted dung..................tons..	20	27	0	0	30	10	0
9	Mineral superphosphate ......cwt..	3	30	0	0	31	15	0
	Potash salts..................do...	2						
	Nitrate of soda...............do...	1						
10	Rotted dung..................tons..	10	26	0	0	31	5	0
	Mineral superphosphate ......cwt..	1½						
11	Bone dust.....................do...	3	24	0	0	27	15	0
	Mineral superphosphate ......do...	1½						

At Escrick Park the fertilizer applied on plot 9, a mixture of mineral superphosphate and potash salts with a small quantity of nitrate of soda, gives much larger returns than any of the other dressings applied; while at Ivor Moor the use of sulphate of ammonia, in combination with the superphosphate and potash salts, gives substantially the same results as are obtained from the employment of nitrate of soda in mixture. The fertilizer indicated on plot 9 is recommended by Professor Voelcker as an economical and beneficial artificial manure for mangolds, on light land. The combination of 10 tons of rotted dung with 1½ hundred-weight of mineral superphosphate gives as good a product, on an average, as is obtained from the application of 20 tons of rotted dung. The products on plots 8 and 10 nearly equal each other in both experiments. A considerable variation is observed in the results obtained from Peruvian guano alone in the two experiments, and Professor Voelcker remarks that, while the exclusive use of mineral phosphatic manures for mangolds on light land is not advisable, on the other hand the best crops are not obtained from the application of manures containing, like Peruvian guano, an excess of nitrogenous compounds. At Ivor Moor the addition of 2 hundred-weight of potash salts to 3 hundred-weight of mineral superphosphate produced fair results, giving about the same yield that was obtained from the addition of 1 hundred-weight of Peruvian guano to the superphosphate; but at Escrick Park the potash salts and superphosphate are decidedly more effective than the guano and superphosphate. In both experiments the mineral superphosphate applied alone ranks low in the scale of productiveness, and appears to be an unsuitable manure for mangolds on light land.

Experiments in feeding.—Prof. J. B. Lawes states that numerous experiments at Rothamsted, England, show that on an average a pig weighing 100 pounds will consume 500 pounds of barley meal, if supplied with as much as he will eat, and double his weight in sixteen or seventeen weeks. This amount of barley meal will contain 420 pounds of dry substance, and in the period of time stated, 74 pounds of this are utilized in the 100 pounds increase of live-weight, 70 pounds pass into the manure, and 276 pounds are expended in respiration and perspiration, or, in other words, in the mere sustenance of life. If, however, the work of fattening be carried on more slowly, and the 500 pounds of

barley meal be distributed over a longer period of time, there will be a less increase in live-weight, the animal expending a larger proportion of this given quantity of food in respiration and perspiration; and the period may be so extended that there will be no increase in live-weight. It is seen, therefore, how important early maturity and rapid fattening of stock are to the pecuniary interest of the grower.

Experiments with six pigs.—Mr. J. S. Griffin, of Levant, Maine, reports his experience in raising pigs during a period of twenty months. April 28, 1868, he purchased two pigs four weeks old, and fed them through the summer with as much milk as they would drink and a little corn meal. In September he commenced feeding boiled potatoes mashed with meal, with milk for drink, continuing this diet until about the middle of October, after which he fed scalded meal and milk until December 1, when the pigs were slaughtered. They were then about eight months old, and weighed, when dressed, 382 and 386 pounds respectively. Two pigs purchased in October, 1868, at the age of four weeks, and fed in like manner, were slaughtered when seven months old; their dressed weight being 240 and 260 pounds respectively. Two pigs were purchased May 14, 1869, at the age of five weeks, and were fed with milk, meal, and boiled potatoes until September 20, after which they were fed with dry corn and meal, with milk for drink. Their weight, when slaughtered, was 250 and 300 pounds, respectively. One of the pigs was lame during the summer, and would probably have taken on more flesh but for this cause. Receipts: Amount of pork from six pigs, 1,818 pounds; worth, at 15 cents per pound, $272 70. Expenses: six pigs, $28; seventy-two bushels of meal, $79 20; small potatoes, $10; total, $117 20. Profits, $155 50. Mr. Griffin advises that pigs be kept in a dry yard and a clean pen, with access to clean water.

Experiments in planting rice.—The following is a report of an experiment made in 1869, by Mr. Henry Shanklin, of Pendleton, South Carolina, in planting "golden rice," on a plot containing 2,000 square yards, or a little more than two-fifths of an acre: he plowed the ground thoroughly, cross-plowed and harrowed; then with a bull-tongue plow laid out rows eighteen inches apart, and planted April 6, using seventeen quarts of seed, covering and pressing down with a hoe, and tracking on the seed with the feet. In the middle of May, after hoeing once and taking out the grass with his fingers, he let on water, which he kept flowing through the rows until July 1. He then turned off, hoed, afterward turned on the water again, and kept it running through the rows until the rice began to turn, when the water was gradually drawn off. The crop was thrashed by hand, and carefully cleaned and measured. The yield was 56½ bushels in the hull, weighing 45 pounds to the bushel, being at the rate of 136¾ bushels per acre.

Cotton seed, crushed and uncrushed.—Mr. Van de Wurt states that, in December, 1868, he measured 10 bushels of cotton seed, which he reduced to 9 bushels by thrashing, and after sprinkling with lime packed away in a close place. At the time of planting corn, selecting two acres, he experimented on one acre with 4½ bushels of the crushed seed, (equivalent to 5 bushels uncrushed,) dropping it near the corn. On the adjoining acre he used 5 bushels of uncrushed seed, well rotted. The result was that the acre which received the crushed seed yielded 30 bushels of corn, while that which received uncrushed seed yielded only 19 bushels. Two acres of cotton also were dressed with the same quantity of crushed and uncrushed seed, applied in the furrow at the time of bedding. The result from the crushed seed was 1,400 pounds of seed cotton per acre; from the uncrushed, 1,000 pounds per acre.

PROGRESS OF INDUSTRIAL EDUCATION.

All the States have now accepted the congressional grant, made under the act of July 2, 1862, for establishing agricultural and mechanical colleges, and the dates of their acceptance were all given in the report for 1867, except the following: Alabama, December 31, 1868; Arkansas, January 31, 1867; Florida, January 30, 1869; Georgia, March 10, 1866; Louisiana, March 5, 1869; Mississippi, October 30, 1866; Missouri, March 17, 1863; Nebraska, February 13, 1869; North Carolina, February 24, 1866; South Carolina, December 14, 1866; Tennessee, February 18, 1868; Texas, November 1, 1866; and Virginia, February 5, 1864. In more than half the States agricultural colleges have been established, and most of them are in operation.

CONNECTICUT.

In the Sheffield Scientific School of Yale College, at New Haven, no material changes have been made since our last report. It is contemplated by the trustees to bring together professors and students in every department of study, and to build up a national central school of pure and applied science.

The faculty consists of Theodore D. Woolsey, president; William Norton, professor of civil engineering and mathematics; William D. Whitney, professor of linguistics and German; Samuel W. Johnson, professor of agriculture; Daniel C. Eaton, professor of botany; Chester S. Lyman, professor of physics and astronomy; William P. Trowbridge, professor of dynamical and mechanical engineering; Geo. H. Brush, professor of metallurgy and mineralogy; Daniel C. Gilman, professor of physical geography and history; Othniel C. Marsh, professor of paleontology; Addison E. Verrill, professor of zoölogy and geology; Eugene C. Delfosse, instructor in French; Louis A. Bail, instructor in drawing; Oscar D. Allen, instructor in metallurgy and assaying; Daniel H. Wells, instructor in analytical and descriptive geometry; Sidney I. Smith, instructor in zoölogy; Mark Bailey, instructor in elocution; Thomas R. Lounsbury, instructor in English; William G. Mixter, instructor in elementary chemistry; Albert B. Hill, instructor in surveying and mechanics; Charles S. Hastings, instructor in physics; Joseph H. Adam, instructor in determinative mineralogy; F. Bacon, instructor in the laws of health; J. F. Weir, instructor in arts of design; General B. S. Roberts, instructor in military science. The professors named constitute the governing board of the institution.

The regular courses of study occupy three years. For admission, the student must pass a thorough examination in Davies's Bourdon's algebra as far as the general theory of equations, or its equivalent; in geometry, in the nine books of Davies's Legendre, or their equivalent; and in plane trigonometry, with analytical trigonometry inclusive; and also in arithmetic, including the metrical system; geography, United States history, and English grammar, including spelling. An acquaintance with the Latin language is also required, sufficient to read and construe some classical author, and Allen's Latin grammar is recommended.

Course of study in the freshman year.—Mathematics: Analytical and descriptive geometry, spherical trigonometry, perspective and surveying, with practical field-work. Chemistry: Recitations and laboratory practice. Physics: Recitations, experimental illustrations of subjects taken up. Language: The commencement of German and lessons in respect to

the use of English, with practice in writing and elocution. Botany: Excursions and lectures. Drawing: Lessons in geometrical, perspective, and free-hand drawing.

At the close of the freshman year the students are assigned to the various sections which embrace the studies they respectively desire to pursue during the remaining years of their course. In each section they also attend to some studies appropriate to other sections. These sections constitute eight special courses, as follows:

1. *Chemistry and metallurgy.*—Analytical chemistry, theoretical organic chemistry, agricultural chemistry, metallurgy, and mineralogy, with weekly exercises in the identification of minerals.

2. *Civil engineering.*—Spherical trigonometry, higher analytical geometry, differential and integral calculus, descriptive geometry and coördinate branches of study; practical surveying with field operations and plotting connected with it; drawing of planes and elevations, shading and tinting, linear perspective, free-hand drawing; construction and operation of machines, utilization of water-power; employment of prime movers, including hydraulic motors and steam-engines; the laying out of curves, and field operations necessary in locating a line of road, establishing the grade, and determining the amount of excavation and of embankment, strength of materials, the establishment of foundations, construction of walls and arches, bridges, roof-trusses, &c., in wood and iron, and the graphics in stone-cutting.

3. *Mechanical or dynamical engineering.*—Mechanical drawing; theoretical or pure mechanics; theory and construction of machines, machinery, and theory of mechanism; the application of the principles of dynamics to the designing and construction of prime movers and other machinery for special purposes; the fabrication of materials used in the construction of machinery; the practical construction of the parts, the fitting up of machinery generally, and the management and control of the same.

4. *Agriculture.*—Agricultural and analytic chemistry, vegetable physiology and botany, zoölogy, entomology, geology, culture of staple crops, principles of stock-breeding and rearing, and rural economy.

5. *Natural history.*—Physiological and structural botany; geology, with excursions to interesting localities, and the study of fossils in the zoölogical laboratory; zoölogy, including comparative anatomy, embryology, &c.; and mineralogy, showing the physiological properties of minerals, crystallization, classification, &c.

6. *Preparation for medical studies.*—Chemical testing of drugs and poisons; comparative anatomy, reproduction, embryology, the laws of hereditary descent, and human parasites; and a general knowledge of structural and physiological botany, and medicinal, food-producing, and poisonous plants.

7. *Studies preparatory to mining.*—The regular course in civil or mechanical engineering, and the fourth year metallurgy, mineralogy, and lectures on mining.

8. *Select studies preparatory to other higher pursuits, to business, &c.*—In addition to insruction in German, French, and English, common to all the departments, the general principles of language, the critical study of the English language in its structure, history, and literature; constant practice in composing; systematic instruction in the physical geography of the globe; in the special, physical, and historical geography of Europe and the United States; in the outlines of modern history and in political economy; in agricultural chemistry, botany, zoölogy, geology, mineralogy, and mathematical astronomy; lectures on agriculture, rural economy, stock-breeding, and on general and theoretical chemistry.

Building and apparatus.—Sheffield Hall is a large and commodious building, containing recitation and lecture rooms for all the classes, a hall for public assemblies and lectures, laboratories for chemical and metallurgical investigations, a photographic room, an astronomical observatory, museums, a library and reading-room, besides studies for some of the professors. The collections belonging to the school are: 1. Apparatus in chemistry, metallurgy, mechanics, photography, and zoölogy. 2. Metallurgic museum of ores, rocks, furnace-products, and an extensive private cabinet of minerals. 3. Agricultural museum of soils, fertilizers, and useful and injurious insects. 4. Astronomical apparatus, consisting of an equatorial telescope by Clark & Son, of Cambridge, and a meridian circle. 5. Cabinet of physiological and mechanical apparatus, constituting the "Collier cabinet." 6. Models in architecture, civil engineering, and descriptive geometry. 7. Mechani-

cal drawings recently given by the Novelty Iron Works in New York. 8. Maps, charts, and reliefs, partly given by the United States Government. 9. Library containing the Hillhouse mathematical library, a general-reference library, and the current English, French, and German scientific journals. 10. Access is also had to the extensive college library, the cabinets in mineralogy, geology, zoölogy, casts, models, designs, &c.

The tuition is $150 per year, with an additional charge of $5 annually for reading-room and gymnasium; $5 to freshmen for chemicals; and to special students in the chemical laboratory $25 per term for materials used. The graduation fee is $10.

Students for 1870 are: Graduates, 28; seniors, 25; juniors, 37; freshmen, 39; specials, 12; total, 141.

DELAWARE.

Delaware College, at Newark, was opened for the reception of students on the 14th of September, 1870, after a suspension of more than ten years.

At a meeting of the board of trustees, held the 19th of July, 1867, a committee was appointed to visit the State legislature, then in session, and endeavor to effect a union between the college and the State, by which the former should receive the annual interest of the congressional grant of land-scrip for establishing a college of agriculture and mechanic arts. An agreement was made by which the State was to give to the college the annual interest, and the trustees on their part were to carry out the object of the grant by establishing a department of agriculture and mechanic arts, and to give the State a joint and equal interest in the property and government of the college. An act was passed by the legislature on the 14th of March, 1867, by which the institution was incorporated anew under the old name, "Delaware College," and the board of trustees made to consist of thirty members, one-half of whom were to be appointed by the governor of the State, and the other half by the members of the old college board. An act amendatory of the act of 1867 was passed February, 1869, by which the powers and duties of the trustees were explicitly defined; and in March of the same year a supplementary act was passed giving the appointment of students admitted free of tuition, being one from each "hundred," to the members of the legislature from their respective hundreds. The new board of trustees organized on the 2d of January, 1869, by the election of Rathwell Wilson, president; John Hickman, vice-president, and George G. Evans, secretary. At a subsequent meeting in May, 1870, they elected several members of the faculty, and voted to open the college on the 14th of September, 1870.

One of the leading objects of the college is to teach such branches of learning as are related to agriculture and the mechanic arts. It is designed especially to give a thorough knowledge of the most approved methods of conducting the practical operations of the farm, garden, and nursery; and to show the results of carefully-conducted experiments, and how they may be made of practical value. Particular attention will be given to the most profitable kinds of farming for Delaware, where the soil and climate are in some respects so peculiar as to render much of the instruction given elsewhere of little practical benefit.

The college embraces three departments: 1. A classical department. 2. A scientific department. 3. An agricultural department. The faculty consists of William H. Purnell, president and professor of moral

philosophy and English literature; Edward D. Porter, professor of agriculture, natural philosophy, and civil engineering; William D. Mackey, professor of mathematics and ancient languages; Charles P. Williams, professor of chemistry, geology, and natural history; Jules Marchert, professor of modern languages and military science; Francis C. Philips, assistant in the laboratory.

The curriculum of study in the agricultural department is as follows:

JUNIOR CLASS—*First term.*—Practical agriculture—Location of farm and division into fields; soils, classification and mechanical treatment; principles of drainage; laying out and construction of drains. Natural sciences—Botany and physiology of plants; principles of germination and growth; analysis and classification. Chemistry—Chemical physics; inorganic chemistry, nomenclature; laws of chemical combination and study of elements. Related studies—Algebra, from quadratic equations; lectures on human anatomy; physiology and laws of health; English composition, language, and literature. *Second term.*—Practical agriculture—Farm implements, principles of construction and use; fencing, hedging, location, and plans of farm buildings. Chemistry—Inorganic chemistry; study of the elements, with laboratory practice; lectures on chemical physics and mineralogy. Natural science—Systematic botany, classification of plants, including a discussion of the general principles of classification in the different departments of natural history. Related studies—Algebra finished; first book of geometry; lectures on anatomy, physiology, and laws of health; study of the English language. *Third term.*—Practical agriculture—Horticulture; hot-beds, their construction and management; methods of propagating plants by layers, cuttings, buddings, grafting, &c.; transplanting varieties of small fruits, and the best means of cultivating them; general nursery management. Chemistry—Lectures on inorganic chemistry; chemical physics and mineralogy, with laboratory practice. Natural science—Practical botany; characteristics and geographical distribution of the natural orders, with their relative importance; genera and species having agricultural, commercial, medicinal, or ornamental value; weeds and poisonous plants. Related studies—Geometry, five books; lectures on anatomy, physiology, and hygiene; modern history.

MIDDLE CLASS—*First term.*—Practical agriculture—General principles of farm economy, care and feeding of stock; manure, composition, manufacture, and application; farm machinery, construction and management. Chemistry—Organic chemistry; qualitative analysis, with laboratory practice in the detection of alkalies and alkaline earths, metals, mineral and organic acids; use of the blow-pipe. Natural sciences—Principles of zoölogy, development, structure, classification, and distribution of animals; principles of geology, dynamical and descriptive. Related studies—Geometry finished; natural philosophy, properties of matter, force, gravity, pendulum, motion, projectiles, mechanical powers; French or German. *Second term.*—Practical agriculture—Animal husbandry, breeds and varieties of domestic animals, dairy-stock, horses, sheep, swine, poultry; principles of breeding, rearing, training, and fattening; composition and preparation of food; management of honey bees. Chemistry—Organic chemistry; qualitative analysis, with laboratory practice in the detection and separation of the elements; chemistry of the germination and nutrition of plants. Natural sciences—Systematic zoölogy, natural orders, families, &c.; embryology, and peculiar modes of reproduction; geology, origin of soils; building materials; coal, coal-oil, and metals. Related studies—Mensuration of lines, surfaces, and solids; measurement of artificers' work, timber, lumber, &c.; natural philosophy, mechanics of fluids; construction and use of barometer, pumps, springs, and wells; French or German. *Third term.*—Practical agriculture—Horticulture, market-gardening, varieties and modes of culture of vegetables and their preparation for market; fruit culture, apples, pears, peaches, plums, grapes, &c.; methods of pruning and training, and study of diseases of fruit trees and insects injurious to vegetation; special attention given to peach culture and management of orchards. Chemistry—Organic chemistry, qualitative analysis, with laboratory practice; chemistry of decomposition and fermentation. Natural science—Entomology, classification of insects, habits of those injurious to vegetation; geology of Delaware and Eastern Shore of Maryland and Virginia, with special study of deposits of marl, limestone, iron ores, and building materials. Related studies—Surveying, with chain, compass, and transit; field-practice and use of instruments; maps of farm surveys; natural philosophy, sound, heat, and light; steam and its applications; construction and uses of thermometers, telescopes, and microscopes; French or German.

SENIOR CLASS—*First term.*—Practical agriculture—Farm economy, principles of rotation of crops, their adaptation to soils and markets; cultivation of farm crops, wheat, corn, grass, and roots, and their preparation for market. Chemistry—Agricultural chemistry, composition of soils, quantitative analysis of domestic manures and ashes of plants. Natural sciences—Lectures on economic geology and mineralogy; diseases of domestic animals, and veterinary surgery and medicine. Related studies—Natural

philosophy, electricity, statical and dynamical; civil engineering, principles of construction, strength of materials; French or German. *Second term.*—Practical agriculture—Agricultural book-keeping, farm accounts; herd-book, farm journal; modes of conducting experiments and making them useful; collection and use of agricultural statistics; history of agriculture. Chemistry—Agricultural chemistry, quantitative analysis of artificial manures, and their influence on plant growth. Natural sciences—Lectures on economic geology and mineralogy; diseases of domestic animals; veterinary surgery and medicine. Related studies—Natural philosophy, magnetism; construction and use of the telegraph; physical geography and meteorology, laws of dews, frosts, fogs, clouds, rain, hail, snow, and winds, with local causes affecting the climate; meteorological instruments, and their use to the farmer; civil engineering, construction of roads, railroads, and canals; French or German. *Third term.*—Practical agriculture—Horticulture, construction and management of hot-houses; cold graperies and orchard houses; landscape gardening and rural architecture; rural law relating to tenure and conveyance of land, highways, cattle, and fences. Chemistry—Agricultural chemistry, quantitative analysis of dairy products; chemistry as applied to the arts of tanning, dyeing, bleaching, and the manufacture of glass, porcelain, and iron. Natural sciences—Excursions for practice in geological surveys and collection of specimens in botany, zoölogy and mineralogy. Related studies—Natural philosophy, electro-dynamics, electrotyping and gilding; civil engineering, field and office work; French or German.

Candidates for admission into this department must be at least fourteen years of age, produce testimonials of good moral character, and sustain an examination in English grammar, geography, arithmetic, the elements of algebra, and history. Students who satisfactorily complete the course of study will be entitled to a diploma as graduate in agriculture. The farm contains about seventy acres of well improved land, consisting of meadow, tillage, and pasture grounds. There are six acres of vegetable garden, eight acres of small fruit trees and vineyard, five acres of apples, pears, peaches, and plums, and the whole farm is well supplied with stock, tools, and farm machinery. All the students, not excused on account of physical disability, are required to labor on the farm one to two hours each day, except Saturday and Sunday, under the direction of the professor of agriculture. Besides this required labor, all students will have an opportunity of working on Saturday, and at such other times as will not interfere with their preparation for the recitation-room, and will receive for such labor eight to twelve cents per hour, according to the work done. The philosophical apparatus of the college is very complete. The State cabinet has also been transferred to the college by an act of the legislature. The different libraries contain about 7,000 volumes. Expenses of students for the year, exclusive of board, are $79 50. Board may be obtained for $3 50 to $4 50 per week.

ILLINOIS.

The Illinois Industrial University, at Urbana, has been open for the reception of students more than two years. During the past year all the fences on both farms have been rebuilt or thoroughly repaired, and about five miles of hedge have been planted. The hedge completely surrounds the farms. Forty-five acres of land sown with oats produced 1,204 bushels, and 175 tons of hay were cut on 120 acres of meadow land. There have been planted in the apple orchard 2,193 trees, and about 600 more have been set in the nursery to remain till a place can be prepared for permanent planting. Shelter belts of maples on the north and south, and of Norway spruce and Austrian pine on the west, were set outside the orchard, and every tenth row in the orchard was left vacant for planting an evergreen wind-break. In the nurseries there have been collected during the year for forest plantations and shelter-belts, 3,000 ash trees, 1,000 white elm, 1,000 American arbor-vitæ, 1,000 balsam fir, 1,000 red pine, 100 Austrian pine, 100 Scotch pine, 18

varieties of the pear, several varieties of the cherry, some tulip and sycamore trees, and 1,300 small evergreens for forest. It is contemplated to commence immediately to plant a timber forest of one acre of each of the most approved species of trees, to determine the actual cost and profit of artificial forests, and the relative value of timber trees which may be grown in Illinois.

Several varieties of different species of small fruits are under cultivation, and it is intended to make large additions in order to test their relative value. Arrangements are also in progress to test a large number of garden seeds and plants and make a full report of the results. Considerable quantities of vegetables have been marketed in the city of Chicago, and also in Urbana and Champaign. A gardener's house has been built recently. A new green house is nearly completed, which will add largely to the facilities of illustration to students, and also be an ornament to the horticultural department.

The university embraces the following departments: 1. Agriculture. 2. Mechanical philosophy and engineering. 3. Chemistry. 4. Natural history. 5. Pure mathematics. 6. Engineering. 7. English language and literature. 8. German language and literature. 9. Latin language and literature. 10. Greek language and literature. 11. History and social science. 12. Commerce. 13. Military science and tactics.

The faculty of instruction consists of John M. Gregory, regent and professor of philosophy and history; William M. Baker, professor of English language and literature; Willard F. Bliss, professor of agriculture; A. P. S. Stuart, professor of theoretical and applied chemistry; Stillman W. Robinson, professor of mechanical science and engineering, and instructor in mining engineering; Thomas J. Burrill, professor of botany and horticulture; S. W. Shattuck, professor of civil engineering, and instructor in mathematics; Edward Snyder, professor of book-keeping and military tactics, and instructor in German; James Bellangee, teacher of architectural and mechanical drawing; Henry M. Douglass, assistant teacher of languages; Robert D. Warder, assistant in chemical laboratory; Alexander Thompson, practical mechanician, and foreman of machine shop; John A. Warder, lecturer on vegetable physiology and fruit-growing; Samuel Tenney, lecturer on zoölogy.

The course of study in the several departments is extensive. Entire liberty of choice is allowed to each student in selecting the studies he will pursue. Changes from one department to another can be made only at the opening of a term.

The apparatus for illustrating the various branches of study is ample and of the best quality. There is a working chemical laboratory with tables for a class of twenty-four students to work at once, and all the appliances needed for making chemical analyses. This season $3,000 worth of new apparatus for illustrating the relations of light, heat, and electricity to chemistry, and their applications to agriculture will be provided. There is also a collection of *papier-maché* flowers, plants, &c., procured from the celebrated Doctor Auzoux, of Paris, several classes of which can be dissected, being so much enlarged as to exhibit to the eye the minute organs which are almost invisible in natural flowers; a collection of fruits and grains magnified to show the organs, structure, coatings, starch, pulp, germs, and various tissues; herbariums and collections of different species of woods, seeds, and grains; and cabinets of insects, birds, reptiles, mammals, shells, skeletons, fossils, minerals, charts, and plates. The university farm and gardens embrace over 1,000 acres of fine improved farming lands, on which large model barns are being built. A veterinary stable is to be erected to illustrate veterinary science, and

papier-maché models of the several parts of the mouth and foot of the horse have been procured to show the structure and motion of these organisms. The library contains over 4,000 volumes, largely scientific.

Tuition in the agricultural, mechanical, engineering, chemical, and military courses is free, a matriculation fee of $10 only being required on entering the university, and $2 50 per term for incidental expenses.

The trustees have voted to admit females as soon as suitable accommodations can be provided. They already attend the lecture courses.

Students are paid for the labor they perform either on the farm or in the workshops, and many young men pay their way through college in this manner.

The college year commences about the first of September, and ends about the first week in June. It is divided into three terms of fourteen, twelve, and ten weeks respectively. Whole number of students during the year, 196. Of these 62 are in the department of agriculture.

IOWA.

No important changes in the plan or course of study, or in the board of instruction, of the Iowa State Agricultural College, at Ames, have been made since our last report. The college has been from its commencement a marked success, especially in the features that distinguish it as an agricultural college. The students, as a body, have shown a steady and hearty sympathy with the government in its plans, policy, and purposes. There has been throughout the year a degree of regularity, promptness, and cheerful obedience rarely surpassed in any institution.

It is the purpose of the college instruction and drill to make proficients in the sciences which underlie the various branches of industry, and by manual labor to produce experts in all its various applications to the operations of the garden, farm, and workshop. For the accomplishment of the former object a thorough knowledge of these branches is required, under the instruction of the professors, in the recitation-room; and of the latter, a practical application of the same by labor in the garden and on the farm. The garden and farm are, therefore, to be brought to a high state of excellence, and in the manner in which they are laid out, in the implements used, in the processes of cultivation, in their order and neatness, and, above all, in their products, they are to be made models and striking examples of the results which artistic skill can reach when properly applied to these departments of industry. They are to exhibit all the modern improvements, to illustrate all the new varieties of fruits, grasses, and esculent roots that are really valuable, and to show to every observer the fact that, when beauty and profit are wisely combined, they ultimately produce the highest profits reckoned in actual cash. Besides these important results, the garden and farm are to be so managed as to contribute something to the progress of agricultural and horticultural science and art, and to settle many important questions in agriculture. Such appears to be the aim of the management. The manual-labor system introduced into the college has succeeded even beyond the expectations of its advocates. Its influence on the health, progress, and conduct of the pupils has been in the highest degree salutary. The president says: "From the experience of the past year, and convictions of a lifetime, I have full faith in the wisdom of the law that requires manual labor from every student, and I believe that such a requisition is indispensable to the prosperity of an industrial school. It gives needful exercise and bodily vigor, imparts skill in the use of tools, helps the student to defray his current expenses, applies science to practice, and promotes respect for honorable toil."

The annual income derived from the rental of lands granted by Congress amounts to about $35,000. The cabinet of the college comprises a collection of minerals and the Schaffer Zoölogical collection. The board of trustees have appropriated $2,000 for purchasing a chemical and philosophical apparatus, and $2,500 for the purchase of books for the nucleus of a library.

The college year commences early in March, and closes near the end of November, leaving the three winter months for the principal vacation, which are profitably employed by many of the students in teaching in the winter schools.

KANSAS.

The faculty of the Kansas State Agricultural College, at Manhattan, consists of Rev. Joseph Denison, president, and professor of mental and moral science and political economy; J. S. Hougham, professor of agricultural and commercial science; J. W. Davidson, professor of military science and tactics and civil engineering, and teacher of French and Spanish; B. F. Mudge, professor of natural science and the higher mathematics; Rev. J. H. Lee, professor of the Latin and Greek languages and literature; J. Evarts Platt, professor of mathematics and vocal music, and principal of the preparatory department; Miss Mary F. Hovey, professor of the German language and literature; Mrs. Hattie V. Werden, teacher of instrumental music.

About half the lands granted to this college by the national government have been sold, and the income from interest on the sales now amounts to $16,000 annually. The State has also this year made a donation of about $30,000, which sum is to be expended principally in developing the agricultural department. It is hoped that this aid will secure an enlargement of the farm to 400 acres. It is proposed to add a department of veterinary science as soon as the funds will permit.

The organization of the labor system among the students has been improved, and twenty acres of green-sward land have been broken up and added to that previously under cultivation, making, in all, sixty acres of cultivated land on which the students labor and on which experimental processes are conducted.

The college has a well-selected library of about 3,000 volumes, which is constantly increasing; also a good assortment of philosophical and chemical apparatus, an extensive cabinet of minerals and ores, and a good collection of specimens illustrating the geology of Kansas.

Tuition is free, except in instrumental music. Contingent fee, $3 a term. Board, $3 25 per week.

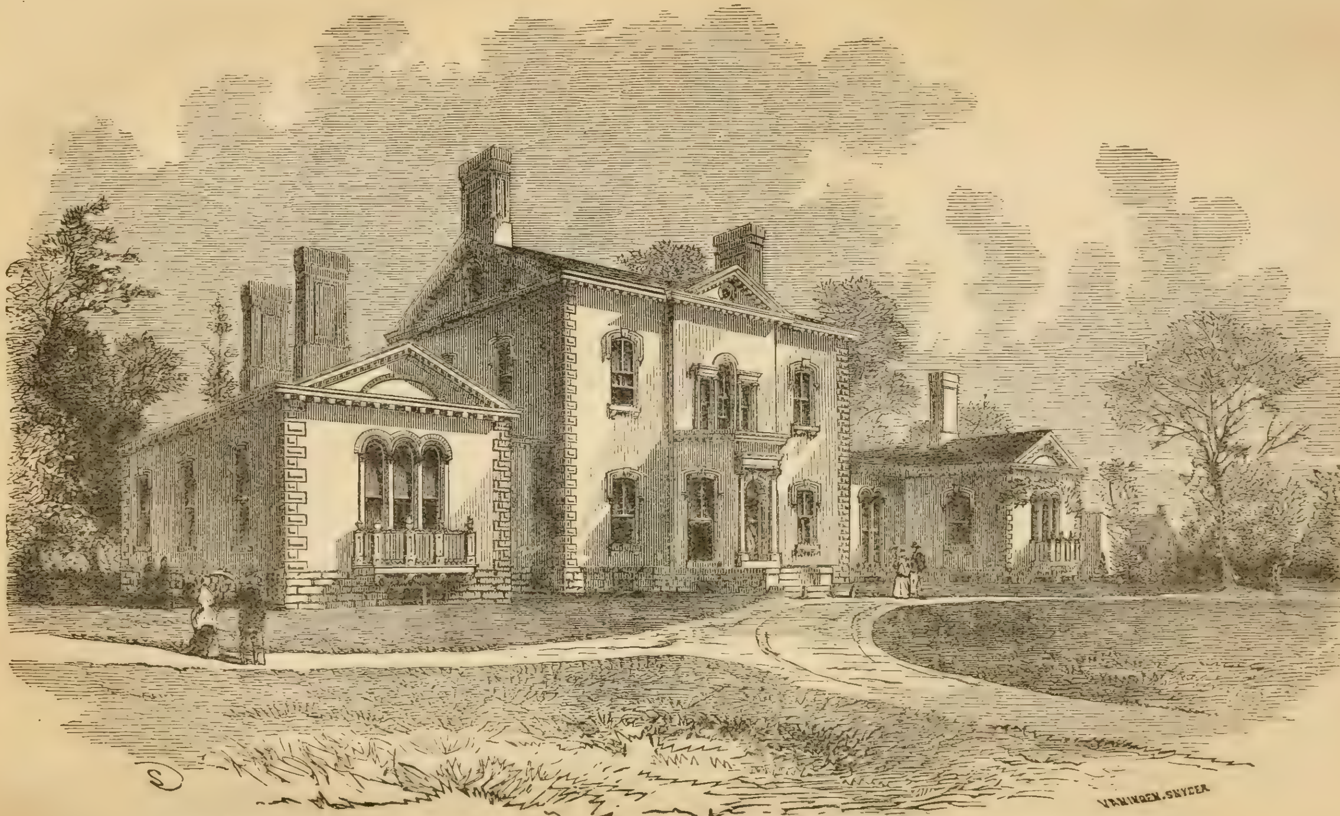
KENTUCKY.

In the annual reports for 1867 and 1869 accounts were given of the establishment of the Agricultural and Mechanical College of Kentucky University, at Lexington, in 1866. It has now been in successful operation nearly five years, and we notice with interest the increasing prosperity of this, the *first* college organized under the act of Congress appropriating lands for the endowment of Industrial Colleges.

The library of the university contains 10,000 volumes. Whole number of students during the year, 819; of these, 300 were in the Agricultural and Mechanical College.

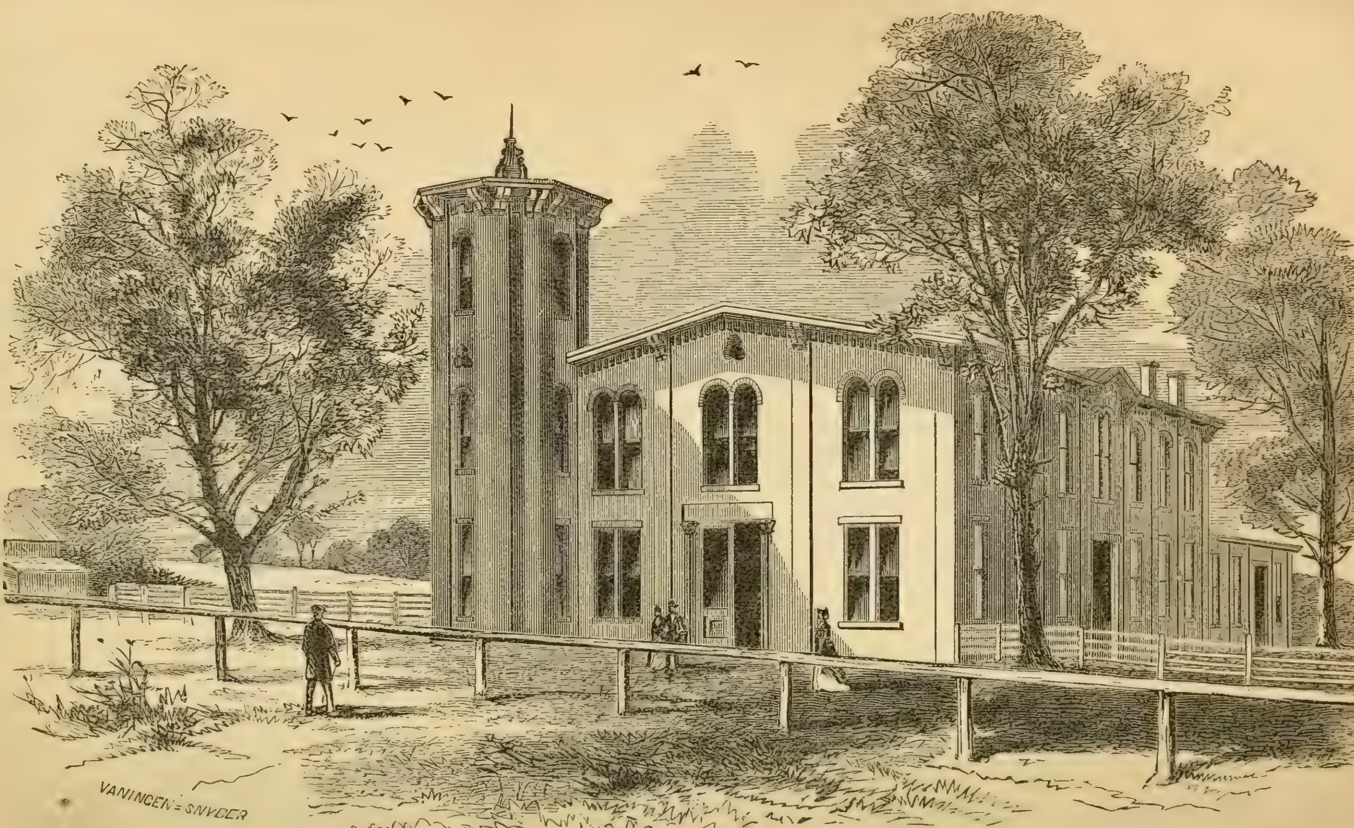
Students are permitted to receive instruction, without extra charge, in any of the classes of the College of Arts, enabling them to study Latin, Greek, &c., and to obtain a thorough classical as well as scientific education.

PLATE XXIX.



ASHLAND.—HOMESTEAD OF HENRY CLAY, NOW THE RESIDENCE OF J. B. BOWMAN, REGENT OF KENTUCKY UNIVERSITY.

PLATE XXX.



MECHANICAL DEPARTMENT OF THE AGRICULTURAL AND MECHANICAL COLLEGE, KENTUCKY UNIVERSITY.

The number of students in attendance at the Agricultural and Mechanical College last session was 300; whole number enrolled in the University, 772. They were from thirty-three States and countries.

The success of this institution is mainly due to the indefatigable exertions of the regent, J. B. Bowman. In reviewing his annual reports we notice the steady development of his plans for continued improvement. Devoting his life, fortune, and energies to the cause of education, it is not surprising that this young institution has made so rapid advancement, and that it now ranks among the very first of its class in the country. The corps of professors numbers more than thirty, many of them distinguished and experienced educators.

The agricultural department.—The college farm is located on the beautiful estate of Ashland, the homestead of Henry Clay, purchased for the purposes of education by Mr. Bowman, the founder and regent of the University.

Practical instruction in agriculture is given in two departments, the compensated and uncompensated, choice of which is left to the student. The labor on the farm, in the garden, and in the mechanical shops is almost entirely performed by the students, where they are required to work two hours daily without pay, except those wishing to pay a portion of the expenses of their education by their labor, who are paid five to ten cents per hour during the first year, and ten to twenty cents during the second and third years, according to the labor performed. Many of the students pay a large part of the expense of their education in this way. The labor is performed under the direction of superintendents skilled in their business. By adopting the club system of boarding, students have reduced their entire annual expenses to about $100 each.

A series of experiments has been made in the manufacture of sorghum sirup from sorghum grown upon the farm, by which a superior article has been obtained, worth $1 per gallon. Ten acres of broom-corn have been planted, from which three hundred dozen brooms have been made, and twenty acres will be planted next season. Additional experiments on the farm will soon be instituted, which, it is hoped, will develop principles of importance both to the student and the agricultural interests of the country. The gardens, orchards, vineyards, and greenhouse plants have been cultivated with much success, and the products sold in the city market, where the college has a permanent stall. Forty cows have been purchased for carrying on the dairy business, from which it is intended to supply the milk for the University boarding-houses and the people of Lexington. Although the farm has not been so profitable as the horticultural department, both have succeeded to the satisfaction of the managers, and ultimate success, as experience matures, is considered certain.

Horticultural department.—This department embraces the ornamental and experimental grounds at Ashland and Woodlands, including gardens, orchards, vineyards, nurseries, propagating houses, greenhouses, and arboreta. Students laboring in this department are under the supervision of a skillful superintendent, who is competent to give them thorough instruction in horticulture and landscape gardening; and they have ample facilities for the practical application of the principles of botany and vegetable physiology, and for a thorough knowledge of the art of grafting, budding, and planting, and the general care and culture of all kinds of trees, shrubs, and flowers.

The mechanical department.—The mechanical department has been organized under the name of the "Ashland Mechanical Works," by the

erection of fine large buildings for shops of various kinds, which have been fitted up with the most approved machinery for the manufacture of all kinds of agricultural and mechanical implements, including reapers and mowers, wagons, plows, and cultivators. And in the woodshops, iron-shops, paint-shops, and shoe-shops, skilled artisans are employed, who, under the general supervision of an experienced superintendent, give practical instruction to a large number of young men in the various mechanic arts. With these liberal and unusual advantages young men have an opportunity of learning a good trade either at the anvil, the lathe, the bench, or with the brush, while at the same time defraying a large portion of the expenses of their education. In the last published catalogue it is shown that several were paid upwards of $100 each; in some few cases, from $250 to $300. These young men received honorable notice, and were rewarded with the first honors. These results prove the advantages of such institutions to industrious and deserving young mechanics ambitious to obtain a practical education. A good beginning has been made in this department. During the year a commodious barn worth $2,100 and a cottage worth $1,000 have been built; fourteen houses, dormitories, and club-buildings thoroughly repaired; seventy-two rooms painted, white-washed, and prepared for occupation; three thousand six hundred and forty-two feet of plank fence built; agricultural implements, barns, and greenhouses repaired; additions made to propagating houses; the small tools for the machine-shop and blacksmith-shop made, besides much other important work necessary to be done on the farm and buildings. Twenty-two two-horse wagons have been manufactured; sixty-four two-horse plows; forty-three one-horse plows; sixty cultivators; fifty patent trucks; twenty-two mowers painted and repaired; thirty-five senior combined Climax machines; five harrows, and much other useful machinery; and one hundred and thirty-five mowers have been painted and set up.

MARYLAND.

The Maryland Agricultural College, at Hyattsville, has opened this year with encouraging prospects. The number of students in attendance is much larger than at any previous time. Regular lessons are given in practical farming, horticulture, floriculture, experimental science, and natural history, to every class in college. A provision has been made for carpenter and blacksmith shops for the benefit of such students as have a taste for these mechanic arts.

The college building is spacious and substantial, and in thorough repair. It has fine and convenient chambers, and is well ventilated and warmed. It is also lighted throughout with gas, and combines every requisite for a comfortable home. The farm, buildings, roads, and lawns are being improved as rapidly as the funds will admit. The college is now free from debt, and the income meets all its liabilities.

The scholastic year is divided into two terms, with one regular vacation, which begins the last week in June, and closes the middle of September.

The first term opens on the 15th of September, and closes with January. The second term begins the 1st of February, and ends with the college year the last of June.

The faculty consists of Rev. Samuel Regester, president and professor of moral science and evidences of natural and revealed religion; Nicholas B. Worthington, professor of mental philosophy, English language, and literature; Alfred Herbert, professor of the natural sciences, including chemistry and its applications, geology, botany, and mineral-

PLATE XXXI.

WOODLANDS.—HORTICULTURAL DEPARTMENT OF KENTUCKY UNIVERSITY.

ogy; Battista Lorino, professor of Latin, Greek, French, German, Italian, and Spanish; Phil. Moore Leakin, professor of mathematics, pure and mixed, including experimental surveying, mensuration, etc.; Francis A. Soper, instructor in military tactics and tutor in mathematics; William E. Waggener, tutor in the preparatory department; and J. Esputa, professor of instrumental and vocal music.

The number of students during the year ending in June, 1870, was 98. The present number is 118, 60 of whom are State students, who receive their tuition and have the use of text-books free of cost. The expense is paid from an annual donation of $6,000, made by the State for this purpose.

MASSACHUSETTS.

In previous reports on the Massachusetts Agricultural College, at Amherst, we have spoken principally of its endowment, buildings, and course of instruction. These objects have thus far required a large share of the attention of the trustees and faculty of the institution. The operations of the farm, the orchard, and the garden, which are of no less interest to the farmer, have not been entirely neglected, however. A foundation has been laid for carrying out the details of scientific and practical agriculture to their full extent. Only within two years has any important step been taken by way of improvement and experiment on the farm. Much time has been expended in laying it out, in fencing, under-draining, grading, and constructing the necessary roads. During the last season there were raised on the farm 150 tons of hay, 700 bushels of corn, 600 bushels of oats, and 600 bushels of potatoes. Two hundred and fifty standard pear trees, 50 peach trees, and 25 apple trees have been set. Also, 2,000 grape vines, mostly Concords, set six feet apart, in rows nine feet apart, and staked with chestnut pickets five feet long. It is designed to support them with wire trellises. Several acres are devoted to small fruits and vegetables. Large quantities of currants, raspberries, strawberries, asparagus, and rhubarb have been set. It is proposed to institute a series of experiments with the sugar-beet, for the purpose of determining what varieties are best suited to the soil and climate of Massachusetts, and what percentage of sugar may be expected from them.

A beginning has been made in stock-breeding. Twelve thoroughbred cattle are on the college farm, consisting of Short-horns, Devons, Ayrshires, and Jerseys, purchased of the best breeders in the country; also about forty natives, besides twenty-five Southdown sheep, and twenty-four swine of the Suffolk, Berkshire, and Chester white breeds.

The theoretical and practical instruction in agriculture has been under the direction of Professor Levi Stockbridge, who has devoted himself with much zeal and success to this department.

The faculty consists of William S. Clark, president, and professor of botany and horticulture; Levi Stockbridge, professor of agriculture; Henry H. Goodell, professor of English, French, and German languages; Samuel F. Miller, professor of mathematics and farm engineering; Charles A. Goessmann, professor of chemistry; Henry E. Alvord, professor of military science and tactics; H. S. Barlow, instructor in rhetoric and elocution; James Law, lecturer on diseases of domestic animals; Charles L. Flint, lecturer on dairy farming; Calvin Cutter, lecturer on hygiene; Joseph White, lecturer on civil polity; Jabez Fisher, lecturer on market gardening; Edward Hitchcock, lecturer on comparative anatomy; Marshall P. Wilder, lecturer on the culture of fruits and flowers, and the art of producing new and valuable varieties;

A. S. Packard, jr., lecturer on useful and injurious insects; E. S. Snell, lecturer on physics; George B. Loring, lecturer on stock-farming; L. Clark Seelye, lecturer on English literature; John Griffin, gardener; A. J. Marks, acting farm superintendent.

MICHIGAN.

The trustees of the State Agricultural College, at Lansing, have completed during the present year a new and commodious dormitory for the accommodation of students, and a farm house for the superintendent of the farm. The lands granted by the national government have been put into the market, and are being rapidly sold under the direction of the agricultural land-grant board, consisting of the governor, auditor general, secretary of state, state treasurer, attorney general, and commissioner of the State land office. It is believed that the income derived from the sale of these lands will soon make the college a self-sustaining institution. The corps of instruction has been enlarged by the addition of a professor in botany and an instructor in the French language.

The faculty as now constituted consists of T. C. Abbot, president and professor of mental philosophy and logic; Manly Miles, professor of practical agriculture, and superintendent of the farm; R. C. Kedzie, professor of chemistry; Sanford Howard,* secretary; George T. Fairchild, professor of English literature; Albert J. Cook, professor of zoölogy and entomology; Will. W. Tracy, instructor in horticulture and superintendent of the gardens; Richard Haigh, jr., assistant secretary; William J. Beal, lecturer on botany; J. J. Golard Fernand, instructor in French; S. S. Rockwell, steward; Charles E. Stowe, foreman of the farm; Edwin Hume, assistant foreman of the farm.

The departments of instruction were given in the report for 1868. The course of study, with the text-books used, is as follows:

FRESHMAN CLASS.—*First half year*—Algebra, Davies; history, Weber; geometry, Robinson; book-keeping, Mayhew. *Second half year*—Trigonometry, Robinson; surveying, Davies; practical agriculture, lectures; geology, Dana.

SOPHOMORE CLASS.—*First half year*—English literature, Chambers, Spaulding; botany, Gray; elementary chemistry, Roscoe. *Second half year*—Entomology, Packard; analytical chemistry, Kedzie; botany, Gray, Darlington, Lindley; horticulture, Thomas, Fuller, Henderson.

JUNIOR CLASS.—*First half year*—Physics, Snell's Olmsted; agricultural chemistry, lectures; inductive logic, Herschel. *Second half year*—Physics, Miller; meteorology, lectures; rhetoric, Whately, Day's Praxis; animal physiology, Dalton.

SENIOR CLASS.—*First half year*—Zoölogy, Carpenter; practical agriculture, lectures; mental philosophy, Wayland; astronomy, Snell's Olmsted; French, Otto. *Second half year*—Landscape gardening, Downing, Kemp; civil engineering, Mahan; moral philosophy, Fairchild; political economy, Carey, Walker; French, Otto, De Fivas.

Among other means of improvement besides the foregoing may be mentioned the college farm of 676 acres, 300 of which are under cultivation; the botanical gardens of trees, shrubs, and herbaceous plants, and a commodious greenhouse; the vegetable gardens, small fruit garden, apple orchard, pear orchard, general lawn, and grounds; the Galloway, Ayrshire, Devon, and Short-horn cattle; Essex, Berkshire, Suffolk, and Chester White swine; Southdown, Cotswold, Spanish Merino, and Black-faced Highland sheep; chemical laboratory and apparatus; philosophical and mathematical apparatus; museum of animals and minerals; the Cooley herbarium; museum of vegetable products; library and reading-room; buildings, workshops, and tools.

Students are paid for the labor they perform on the farm according

* Deceased since the record was prepared.

to their ability and fidelity. The highest wages paid the present year have been seven and a half cents per hour.

Persons who desire to pursue any of the branches related to agriculture, such as chemistry, botany, animal physiology, etc., may be received for a shorter period than is required for a full course. Candidates for admission into the freshman class must not be less than fifteen years of age, and must sustain a thorough examination in arithmetic, geography, grammar, reading, spelling, and penmanship.

Whole number of students in the college for the year, 129; of which 81 were in the agricultural course, 2 in the special course, 36 in the preparatory course, and 10 are ladies.

MINNESOTA.

The design of the University of Minnesota, at St. Anthony, is to enable the student, after he leaves the public high-school, to complete his education by such course of additional study as he may designate. At present the university is doing in its preparatory school much of the work of the high schools, which, owing to their limited number, they are not yet able to perform. As soon as these high schools can do all of this work it is proposed to dispense with the preparatory school, and it is announced by the board of regents that the English branch will be discontinued at the close of the academic year 1870–'71. The several departments of the university, as now organized and in operation, are as follows: 1. The preparatory school; 2. The collegiate department; 3. The college of science, literature, and the arts; 4. The college of agriculture and the mechanic arts. It is designed to organize a department of law and a department of medicine as soon as the means of the university will permit.

The faculty of the college of agriculture and the mechanic arts consists of William W. Folwell, president; Daniel A. Robertson, professor of agriculture; Richard W. Johnson, professor of military science; Arthur Beardsley, professor of civil engineering and industrial mechanics; Edward H. Twining, professor of chemistry and instructor in natural sciences and in French; Mahlon Bainbridge, superintendent of the farm and instructor in practical agriculture.

The course of instruction in agriculture embraces the following branches and plan of study:

1. *Chemistry;* including geology and mineralogy, with practical instructions in the nature and origin of soils and their analysis, fertilizers, food, processes of the dairy, sugar-factory, &c.
2. *Botany;* with practical instructions in horticulture and pomology, arboriculture, improvement of varieties, cereals, textile fabrics, &c.
3. *Zoölogy;* including anatomy, entomology, and ornithology, with practical instructions in stock-breeding, veterinary science, insects injurious to vegetation, poultry, and pisciculture.
4. *Physics;* including meteorology and climatology, with practical instructions on the effects of light, heat, and electricity, theory of winds and storms, and acclimation of plants and animals.
5. *Mechanics;* including engineering, architecture, with practical instructions in construction and tests of farm implements and machinery, roads, ditching, fencing, farm buildings, and grounds.
6. *Economics;* with practical instructions in the general theory and practice of agriculture, rent, wages, accounts, markets, and transportation.
7. *Jurisprudence;* including the history and literature of agriculture, with tenures of lands, laws of highways, taxation, estrays, contracts, etc.

This course of study occupies two years. Applicants who have completed any scientific course of the collegiate department are admitted without further examination. Other applicants must be at least sixteen years of age, and pass satisfactory examinations in the English language,

arithmetic, algebra, geometry, plain trigonometry, mensuration, industrial drawing, geography, and elements of botany, zoölogy, chemistry, physics, and general history. Students who satisfactorily complete the course of study in this department will receive the degree of bachelor of agriculture, but any person not a candidate for this degree, who appears to be competent to receive the instruction given, may attend the classes and undergo examination in any subject, and if successful, will receive a certificate to that effect. A special course of instruction in this department will be opened about the 1st of November, and continue during the winter months, if there should be a sufficient number of applications to warrant the undertaking.

The scholastic year commences near the 1st of September, and closes about the end of June. It is divided into three terms, with three vacations. Tuition in all the departments is free. Board in families may be obtained for $4 per week. In the boarding club it has not exceeded $2 per week.

MISSOURI.

The act of the legislature for locating the Agricultural and Mechanical College, in connection with the University of the State of Missouri, at Columbia, Daniel Read, LL. D., president, was approved February 24, 1870, and the conditions required of the citizens of Boone County, to donate $30,000 and an experimental farm of not less than 640 acres, were complied with on the 3d of June following. Measures were immediately taken to put this college into operation, and one professor of agriculture, G. C. Swallow, the State geologist, has been appointed, and a class formed which is now receiving instruction from Prof. Swallow and the professors of the university in the different branches which form the course of study in this department. Sufficient income will not for some time be derived from the land granted by Congress for the support of a full corps of professors, but the agricultural course will be continued in connection with the university, and be enlarged by adding new studies and increasing the number of professors as the pecuniary means permit, till a college complete in itself, with an independent faculty, is established. Arrangements will be made immediately for the employment of students in cultivating the university garden and making improvements and experiments on the farm, by which they may be able to pay a portion of the expense incurred in pursuing their college course.

The farm is beautifully located on the north side of the Missouri River, and contains a valuable mansion worth $15,000 or $20,000, which is of special value for the accommodation of students, and two large vineyards in a flourishing condition. By the terms of the law, this land can never be converted to any other use than that of the college farm for instruction in practical and scientific agriculture.

In conducting experiments on the farm, the land is to be divided into fields, each to be designated by a particular name. The quantity of ground devoted to each experiment and the character of the soil are to be accurately defined. If cultivated, the mode of treatment of the crop, the cost, and the profit and loss are to be definitely stated, and credited or charged to the farm, as the case may be. Students working on the farm or in the garden will be allowed ten to fifteen cents per hour, according to their skill and the amount of work performed.

Three-fourths of the income derived from the lands given by the congressional grant are to be appropriated for the support of the Agricultural and Mechanical College, and one-fourth for the support of the School of Mines and Metallurgy. Proposals were made by different

counties for the location of the latter in their territory. Iron County offered to give $83,000, 5,000 acres of land, and 20 acres for a site for the school; Phelps County, $75,000, 7,500 acres of land, and a site. It has been recently located at Rolla, in Phelps County, where a college building, costing about $15,000, is soon to be erected.

Whole number of students in the University during the year, 243. A portion of these have been pursuing agricultural studies.

NEBRASKA.

The congressional grant of 90,000 acres in land scrip, made to the State of Nebraska, has been accepted, and commissioners have been appointed to select the lands. In order to carry out the object of the National Government in making this donation, the legislature of the State passed an act, approved February 15, 1869, to establish a University to be called the University of Nebraska. It is located at Lincoln, the capital of the State, and is governed by a board of regents, consisting of the governor, the superintendent of public instruction, the chancellor of the University, and three persons from each judicial district, appointed by the legislature. The University embraces six departments: 1. A college of ancient and modern literature, mathematics, and natural science; 2. A college of agriculture; 3. A college of law; 4. A college of medicine; 5. A college of practical science, civil engineering, and mechanics; 6. A college of fine arts. Each department or college will have a corps of instructors, and when the plan of instruction is fully developed, and all the colleges are in operation, fifty professors will be required to constitute the different faculties. The several buildings of the University are to be erected within a radius of four miles from the State-house, and the immediate government of each college will be by its own faculty.

No person is to be deprived of the privileges of the institution because of age, sex, color, or nationality. A matriculation fee of $5 will be required for admission into any department of the University; but applicants residing within the State, or, being non-residents, who pay, or whose parents pay, a school-tax of $30 or more to the State, and who pass the prescribed examinations successfully, will not be required to pay any tuition during the term of four years. All other students, and all who elect to remain under instruction for a longer time than four years, will be required to pay such fees as the board of regents may determine. Persons who produce a certificate from a county superintendent of the common schools, certifying that they have passed honorably through the course of study prescribed in a high school under the common-school laws of the State, may be admitted to any college of the University without further examination. Other applicants for admission will be required to pass an examination in the course of studies prescribed by the board of regents.

In the College of Agriculture there are to be six professors: A professor of applied chemistry, of botany, of agriculture, of horticulture, of meteorology and climatology, of veterinary surgery, and a superintendent of the model farm.

In February, 1869, the legislature of the State appropriated $100,000 to be derived from the sale of its own lands, for the "construction and erection of a suitable building for a State University and agricultural college." In pursuance of this act a beautiful four-story building has been erected at Lincoln during the present year, and is now ready for occupancy. The board of regents are about to organize the faculty and prescribe a curriculum of study, and the University will soon be opened for the reception of students. Two sections of the State lands have been

set apart for a model farm, upon which improvements will be commenced as soon as the agricultural college is opened.

NEW HAMPSHIRE.

The trustees of the New Hampshire College of Agriculture and Mechanic Arts, at Hanover, are making progress in establishing this institution on a firm basis. The general government of the institution is vested in nine trustees, five of whom are appointed by the governor of the State, and four by the trustees of Dartmouth College. Its connection, therefore, with Dartmouth College is such as to secure to it all the advantages which can result from the wisdom and experience of that institution, and at the same time enable it to retain all the rights and privileges which pertain to it as a separate organization in accomplishing the particular objects for which it was established.

The new college building is now nearly completed, and will soon be opened for the reception of students. It is called Culver Hall, in honor of the late David Culver, who was the principal contributor to its erection. It is a large and elegant building, 100 feet long by 60 wide, and four stories high. The basement is made of granite, and the superstructure of bricks of the best quality. The rooms of the first story are designed as depositories for improved agricultural implements and models of machinery employed in the mechanic arts. The second contains a lecture-room sufficiently large to accommodate 500 persons, a chemical laboratory for the use of students, and a room for a library. In the third story are recitation-rooms, a room for lectures on natural history, and one for a museum of the agricultural products of the State. The fourth is designed for the museum of natural history. The building is complete in all its arrangements, and surpasses all other buildings which have been erected in connection with Dartmouth College. For the erection of this building $25,000 were derived from the estate of Mr. Culver, $15,000 were appropriated by the State legislature, and $12,000 have been received from private donations.

The college farm contains 158 acres of excellent land, and embraces a great variety of soils. It joins the college grounds on which Culver Hall is situated. Seventy-two acres of the farm are tillage land, twelve acres wood land, and the remainder pasturage. Nearly all the land could be easily converted into tillage if desired. The farm was purchased by Hon. John Conant, and presented to the college, and in his honor it has been named the Conant farm. Mr. Conant has accumulated a property of $100,000 by farming, and has done honor to himself and the fraternity of farmers by his liberality, not only to this institution but to many others of his State.

The faculty is the same as given in the report of 1868, with the addition of David French Thompson, instructor in drawing. The curriculum of study in the college of agriculture and the mechanic arts is as follows:

JUNIOR YEAR, (*both courses alike.*)—FIRST TERM: Mathematics—Loomis's algebra; botany—structure and physiology of plants, Gray; physics—physical geography; drawing—free-hand, Chapman; book-keeping—Crittenden's, counting-house edition. SECOND TERM: Mathematics—algebra completed, Loomis's geometry; botany—characteristics of plants and their classification; drawing—free-hand, Chapman; chemistry—chemical physics, metallic and non-metallic elements and their compounds, and lectures.

MIDDLE YEAR, (*course in agriculture.*)—FIRST TERM: Mathematics—Loomis's trigonometry, surveying and leveling, with the use of the instruments and practice in the field, drawing of plans and maps, lectures on civil engineering; practical botany—useful and noxious plants, propagation of plants, fruits, &c.; organic chemistry—gums, sugar, alcohol, essential oils, organic acids and bases, fermentation, putrefaction,

&c., and lectures. SECOND TERM: Mathematics—geometry completed, mensuration and navigation, spherical trigonometry; analytical chemistry, Attfield's and Bowman's; physics—Loomis's natural philosophy; zoölogy—human and comparative anatomy.

Course in mechanic arts.—FIRST TERM: Mathematics—Loomis's trigonometry, surveying and leveling, with the use of the instruments and practice in the field, drawing of plans and maps, lectures on civil engineering; descriptive geometry, Church's; organic chemistry—gums, alcohol, essential oils, organic bases, fermentation, putrefaction, &c., lectures. SECOND TERM: Mathematics—geometry completed, mensuration and navigation, spherical trigonometry; analytical chemistry, Attfield's and Bowman's; physics—Loomis's natural philosophy; zoölogy—human and comparative anatomy.

SENIOR YEAR, (*course in agriculture.*)—FIRST TERM: Agricultural chemistry—soils, manures, natural and artificial, and various farm crops; zoölogy—general principles, classification, and special relations to agriculture; physics—astronomy and meteorology, Loomis's and Brocklesby, and lectures; political economy. SECOND TERM: Agricultural chemistry—use of the various crops in the feeding of stock, and the production of milk, butter, cheese, fruit, &c.; zoölogy—human and comparative physiology, and veterinary medicine and surgery; rural economy—lectures; intellectual and moral philosophy, Haven.

Course in mechanic arts.—FIRST TERM: Chemistry—the analysis of rocks, ores, minerals, and organic bodies; mechanics—the principles of mechanism applied to the strength of materials, the working of stone, the location and construction of roads, and the building of bridges, including graphical problems; physics—astronomy and meteorology, Loomis and Brocklesby; political economy. SECOND TERM: Technical chemistry—the construction and management of iron-works, glass-works, bleaching-works, salt-works, dyeing and calico printing; technical mechanics—lectures on mill-work and other topics relating to manufacturing industry; also, on applied electricity; intellectual and moral philosohy, Haven.

There are now about 1,000 volumes in the library of this college. The State museum of general and applied science contains about 10,000 specimens, a part of which has been purchased in Europe, and the remainder contributed by the State and individuals. It is intended to make large additions to this collection at an early date.

NEW JERSEY.

The faculty of Rutgers Scientific School, at New Brunswick, Rev. W. H. Campbell, president, which is designated, by an act of the legislature of New Jersey, the "State College for the Benefit of Agriculture and the Mechanic Arts," is the same as given in our last report, with the addition of one professor recently appointed to fill the chair of analytical chemistry, which has been established and endowed during the present year. The chair of mining and metallurgy has also been fully endowed.

The two principal courses of study, namely, civil engineering and mechanics and chemistry and agriculture, have been extended from three years to four. The number and difficulty of the subjects pursued rendered this measure absolutely indispensable to the successful working of the school.

The recitation-rooms have been enlarged and improved, and thoroughly refurnished. Means have been provided for building a new "geological hall," with rooms for a geological museum, recitations, etc., and it is to be erected at an early day.

Under the direction of Professor George H. Cook, the college farm is rapidly recovering from its condition as a "worn-out" place, and very strikingly exhibits the sound economy of abundant fertilizing and careful underdraining. It is also being stocked with thorough-bred cows.

The number of students for the year ending in June, 1870, is 46. There are more students in the school now than at any former period, the incoming class numbering 27. The trustees give diplomas conferring the

degree of bachelor of science on all members of the graduating class in full and regular standing.

OHIO.

The Agricultural and Mechanical College of Ohio, at Columbus, was incorporated by an act of the legislature the 22d of March, 1870. On the 18th of April following an additional act was passed authorizing the several counties of the State to raise money to secure the location of the college. Several of the interior counties made liberal proposals. Montgomery County offered $400,000; Champaign, $200,000; Clarke, $200,000; and Franklin, $300,000. In September of the same year the board of trustees determined that, on account of the central position local advantages, and the generous donation of Franklin County, the Agricultural and Mechanical College of Ohio should be permanently located at Columbus. The board selected from the several farms offered in different localities, the "Neil farm," situated about two miles north of the State-house, and containing, with an adjoining lot, 378 acres, for which they have agreed to pay $103,000.

A farm superintendent has been appointed, and is making preparations to engage, in the spring, in such operations and farm experiments as the board shall direct. This winter the board will complete and adopt their plans for the college buildings, and commence erecting them as soon as the season will permit. They will also devise a plan for the organization of the college, which it is intended to establish on a broad and liberal basis, adequate to the wants of the State, and in such a way as to carry out faithfully the requirements and spirit both of the congressional and State enactments.

The fund derived from the sales of land scrip, and from interest accumulated, now amounts to $500,000. The annual interest derived from this fund is $30,000. As the board are able to pay for the farm, and erect the necessary college and farm buildings from the liberal donations of the citizens of Franklin County, the $30,000 annual income from the fund will be applied to the support of an able corps of professors, and to the payment of other expenses connected with the college.

VERMONT.

The faculty of the University of Vermont and State Agricultural College, at Burlington, consists of James Burrill Angell, president; professors: Samuel White Thayer, Walter Carpenter, Rev. McKendree Petty, Joseph Perkins, Matthew Henry Buckman, John Ordronaux, Alpheus Benning Crosby, Peter Collier, Henry Williamson Haynes, Edward Swift Dunster, Rev. Henry A. P. Torrey, Volney Giles Barbour, George Henry Perkins, and Louis Pollens, instructor.

The departments of the University and college are as follows: 1. The academical department; 2. The agricultural and scientific department; 3. The medical department. The agricultural and scientific department embraces a course (A) in civil engineering; (B) in metallurgy and mining engineering; (C) in chemistry; and (D) in agriculture. The several courses of study pursued in this department are as follows:

FIRST YEAR, (same for A, B, C, and D.)—*First term:* Algebra, Loomis's; geometry, Loomis's; chemistry—laboratory practice and recitations, Eliot and Storer's. *Second term:* Geometry, Loomis's; chemistry—laboratory practice and recitations, Eliot and Storer's; French; geometrical drawings, Warren's. *Third term:* Geometry, Loomis's; French; chemistry—qualitative and laboratory practice, Fresenius's; drawing, principles of perspective.

SECOND YEAR, (same for A and B.)—*First term:* Trigonometry, plane and spherical, Loomis's; descriptive geometry, Church's; chain and compass surveying; physics,

Silliman's. *Second term:* Analytical geometry, Loomis's; descriptive geometry, Church's; physics, Silliman's; German; botany, Gray's. *Third term:* Isometrical drawing, Church's; surveying and plotting; botany, Gray's; physics, Silliman's.

(C.) *First term:* Physics, Silliman's; general chemistry—lectures and recitations, Bloxam's: laboratory practice; trigonometry; qualitative analysis, Fresenius's. *Second term:* Physics, Silliman's; general chemistry, Bloxam's; qualitative analysis; laboratory practice, Fresenius's. *Third term:* Physics, Silliman's; quantitative analysis; laboratory practice, Fresenius's; mineralogy; lectures.

(D.) *First term:* Physics, Silliman's; general chemistry, Bloxam's; plane and spherical trigonometry, Loomis's; chain and compass surveys; German. *Second term:* Physics, Silliman's; German; general chemistry—recitations, Bloxam's; botany, Gray's; laboratory practice, Fresenius's. *Third term:* Physics, Silliman's; botany, Gray's; mineralogy, lectures; laboratory practice; quantitative analysis, Fresenius's.

THIRD YEAR. (A.)—*First term:* Harbor and river surveying; analytical geometry of three dimensions, Davies's; shades and shadows, Church's; isometrical drawing, Church's. *Second term:* Differential calculus, Loomis's; mechanics, Peck's; drawing; linear perspective, Church's; topographical drawing, Smith's; shading and tinting. *Third term:* Integral calculus, Loomis's; hydrographical and topographical surveying and drawing; astronomy, Loomis's; rhetoric.

(B.) *First term:* Shades and shadows, Church's; isometrical drawings, Church's; chemistry, laboratory practice; quantitative analysis, Fresenius's: recitations and lectures; general chemistry, lectures. *Second term:* Mechanics, Peck's; linear perspective, Church's; topographical drawing, Smith's; laboratory practice—quantitative analysis, Fresenius's. *Third term:* Topographical and mining surveying; surveying and drawing; astronomy, Loomis's; mineralogy, lectures; use of the blow-pipe and determinative mineralogy, Elderhorst's; general metallurgical processes, fuel, &c., Kerl; rhetoric.

(C.) *First term:* Laboratory practice; examination of poisons; analysis; physiology and zoölogy. *Second term:* Botany, Gray's; zoölogy, anatomy, and physiology, lectures; assaying of ores; mineral water analysis; laboratory practice. *Third term:* Botany, Gray's; geology, lectures; general metallurgy, lectures; volumetric analysis; laboratory practice—use of blowpipe and determinative mineralogy, Elderhorst's; rhetoric.

(D.) *First term:* Mineral analysis; agricultural chemistry, Johnson's; recitations; analysis of ash of plants; soils and fertilizers; zoölogy and physiology; laboratory practice. *Second term:* Meteorology, Loomis's; mechanics, Peck's; botany, Gray's; anatomy and physiology, lectures; laboratory practice; volumetric analysis. *Third term:* Use of blowpipe and determinative mineralogy, Elderhorst's; botany, Gray's; geology, lectures; organic analysis; laboratory practice; rhetoric.

FOURTH YEAR, (A.)—*First term:* Railroad surveying, Henck's; location of roads and laying out of curves; drawing maps, profiles, and sections; geodesy, coast survey methods; bridge construction, Haupt's; structural drawing. *Second term:* Higher mechanics; steam engine and other prime movers; stability of structures; strength of materials; hydraulics; theory of arches, Woodbury's; stone-cutting, Mahan's; history. *Third term:* Geology, lectures; civil engineering, Mahan's; properties of building materials; foundations; lithology and economic mineralogy, lectures; practical astronomy; designing of structures.

(B.) *First term:* Structural drawing; special metallurgy, Kerl; recitations; assaying of ores; quantitative analysis, Fresenius's; laboratory practice. *Second term:* Higher mechanics; steam engine and other prime movers; stability of structures; strength of materials; hydraulics; assaying continued; special metallurgy; recitations, Kerl. *Third term:* Geology, lectures; designing of structures; volumetric assay; practical mining; ventilation; draining; sinking shafts; tunneling, and dressing ores.

(C.) *First term:* Drawing; laboratory practice; agricultural chemistry; analysis of agricultural products; recitations and lectures, Johnson's. *Second term:* Laboratory practice; analysis of soils and fertilizers; mechanics, Peck's. *Third term:* Laboratory practice; organic analysis; analysis of technical products; preparation of chemical products.

The library of the University contains about 15,000 volumes. Important additions have recently been made to the cabinet of natural history, which now contains 3,500 lithological specimens, 3,000 mineralogical, 1,030 metallurgical, 3,000 geological, 6,000 conchological, 350 ornithological, 1,600 zoölogical, 10,000 botanical, 200 archæological, and 250 numismatic. Besides these, there are 10,000 zoölogical specimens, 5,000 geological, and 3,000 miscellaneous, belonging to individuals connected with the University, to all of which the students have access.

The scholastic year commences about the first of September, and

closes near the end of July, having three vacations. Whole number of students in the University and college, for the year, 115. Of this number, 23 are in the scientific and agricultural department.

WEST VIRGINIA.

The faculty of West Virginia University, at Morgantown, consists of Rev. Alex. Martin, president and professor of mental and moral science; F. S. Lyon, vice-president and professor of English literature and principal of preparatory department; S. G. Stevens, secretary and professor of astronomy and physics; H. H. Pierce, professor of mathematics and military tactics; J. J. Stevenson, professor of chemistry and natural history; F. W. Wood, professor of ancient and modern languages; O. W. Miller, tutor; D. B. Purinton, tutor in preparatory department; George M. Hagans, superintendent of grounds and buildings; Hugh W. Brock, lecturer on physiology and hygiene; John A. Dillie, lecturer on civil and constitutional law; H. H. Pierce, register and librarian; A. G. Alcott, teacher of elocution.

It is the design of the board of regents to make this University, by the thoroughness of its discipline and culture, as well as in its adaptation to the demands of the age, "deserving of no second-rate position among the institutions of our land." The legislature at its last session made a special appropriation of $22,855 to finish the University hall, which is now completed, and is a model of architectural beauty and convenient arrangement. It contains laboratory, office, and recitation rooms, rooms for the preparatory department and library, and a chapel 52 by 40 feet, with gallery; also rooms for the cabinet and museum, and two free halls for literary societies connected with the University. The grounds inclose more than twenty acres, which are tastefully laid out and surrounded with scenery of rare beauty. A part of this land is cultivated for experimental purposes in agriculture. The remainder is ornamented with forest and fruit trees, shrubbery, &c. Dr. B. Sears has made from the Peabody Educational Fund an annual appropriation of $500 for the education of indigent young men.

There are now six departments of instruction in successful operation, viz, a preparatory department, literary department, scientific department, engineering department, agricultural department, and military department.

The library contains about 1,500 volumes of carefully-selected books and standard works in the departments of history, biography, agriculture, theology, art, science, and general literature.

The apparatus is sufficiently extensive for a thorough illustration of chemistry and physics. The museum embraces collections in mineralogy, geology, natural history, and paleontology, with characteristic specimens from all the geological formations.

WISCONSIN.

The most important change which has been made since our last report is the introduction of one term of agricultural studies into the regular scientific course of the University during the winter of the sophomore year. In consequence of this change all the scientific students in the University will attend one course of lectures on agriculture. Agricultural experiments are conducted on the farm, in which the students have an opportunity of participating.

Students who have satisfactorily completed the three-years' course of study can graduate and receive the degree of bachelor of philosophy.

The University library comprises nearly 4,000 volumes, which the stu-

dents of all the departments are permitted to use free of expense. They also have permission to consult, without charge, the historical and State libraries, the former of which contains 35,000 volumes, and the latter a choice collection of miscellaneous works and a complete law library. There are also extensive and valuable geological and mineralogical cabinets and collections in natural history, besides well-selected philosophical and chemical apparatus.

One student from each assembly district is admitted into the University free of charge. To all others the tuition is $6 per term, with $2 for room rent. Board in clubs or private families will not exceed $3 per week. The number of students in the college of arts for the year ending June, 1870, is 94.

STATE REPORTS OF AGRICULTURE.

The annual reports of the agricultural organizations of Missouri, California, Michigan, Wisconsin, Massachusetts, New York, Illinois, Ohio, Iowa, and Connecticut, for 1869, have been received, embracing all that have been published, as far as is known to the Department. A concise abstract of the most important features of each is given. The discussions at the meetings of the boards contain many valuable suggestions, though remarks are sometimes made that will not bear indorsement. The essays and lectures appear to have been well considered, and comprise the results of many actual experiments.

CONNECTICUT.

The fourth annual report of the State board of agriculture of Connecticut has been prepared and its original papers arranged by the secretary, T. S. Gold. It embodies the discussions at the meetings of the board, and several original articles, of which the leading subjects are swine, poultry, sheep and sheep husbandry, horses and their common ailments, and a second report on commercial fertilizers, with an analysis of their contents and their actual money value to farmers. These papers are generally replies to queries propounded in a circular addressed to leading farmers throughout the State, and contain much information on the present condition of its agriculture. There are two lectures by Professor A. E. Verrill, on the external and internal parasites of domestic animals, liberally illustrated, forming a convenient treatise on the subject; also one by Dr. N. Cressey, on the natural history and pathological osteology of the horse; and another by Professor James Law, on the common ailments of the horse, and their prevention.

Mr. Richard Goodman, of Lenox, Massachusetts, in a communication to the board, suggests that as a rule the farmers of New England eat too much pork as their daily food; men work off its effects, but the women, confined by in-door employment, exhibit its evil results in poor complexions, diseased bodies, and general want of stamina. To raise healthy boys and beautiful girls a greater variety of food is needed. He recommends placing promising steers on good pasture and early cut hay, so that every year one could be put into the beef-barrel, and after the first two years one could be killed at that age every fall; so that, with poultry and mutton occasionally, a good variety of food may be always available, and at a cost not higher than that of pork at the usual expense of raising corn in New England. The Chester White pigs are considered the best breed in the country; they are small-boned, easily

fattened, and if regularly fed they seldom squeal in the pen, but take their food, lie down, and fatten fast. They thrive best on cooked food; cracked rye is excellent for this purpose. A reasonable allowance of potatoes, pumpkins, and other vegetables, with meal and skim-milk, is better than feeding on meal alone, to produce a rapid and healthy growth of flesh. Clods of fresh earth should be thrown into their pens every few days. There is something about the fresh soil grateful to their health and thrift. A visible improvement in the breed of swine has been noticed for the last twenty-five years in all parts of the State; the mixture of the Chester White, the Suffolk, and other breeds, having produced a finer form, with less offal, and greater disposition to fatten.

Mr. Verrill's lectures on the external and internal parasites of domestic animals, and their effects and remedies, are a valuable contribution to the report. Farmers will here find descriptions, with drawings, of the numerous insects that annoy and afflict their live stock; as fleas, ticks, bot-flies, meat-flies, poultry-lice, &c., with the modes of prevention or remedy. We extract the following paragraph:

> The best and simplest, as well as safest, wash to destroy fleas, mites, itch-insects, mange acari, and all external parasites of men and animals, (and probably the mange in horses,) is a solution of sulphuret of potassium in water, say two to four ounces to a gallon of cold water, varying the strength according to the age and the tenderness of the skin of the animal, as the solution will contain some potash, which, if too strong, would irritate a delicate skin. There is no danger in its application, but it has the disagreeable odor of sulphuretted hydrogen. This sulphuret of potassium comes in the form of greenish or grayish lumps, put up in tight bottles. It is used in photography, and can usually be bought at the principal drug stores.

Carbolic acid, diluted in water, is also recommended as an excellent wash for killing most kinds of parasites.

Mr. Bissell, of East Windsor, recommends shearing sheep before they are turned out to pasture. This prevents a loss of wool by their shedding it on bushes, &c., and it is also cleaner and freer from grit or sand. At the discussions before the board, it was held that sheep subdue the coarse plants, and sweeten the pasture more than sufficient to compensate for what they eat. They go better after cattle than before them, and destroy the white-weed and briers on the farm wherever they lie. On land formerly overrun with the white daisy, since sheep have been kept, not a daisy can be found. Sheep bring up a run-down farm sooner than any other kind of stock. They like variety, and if properly fed will return more value of flesh than any animal raised in the State. It is claimed that in England the amount of grain raised is not diminished, but rather increased, by the vast number of sheep maintained there.

It is assumed that for mutton sheep, now the chief source of profit in Connecticut, there is no breed that surpasses the South Downs. They are quiet and hardy, yield a good fleece, and are also good mothers, and have a free flow of milk for their lambs; and if in decent condition, their lambs will thrive so that increase of growth can be noticed almost from day to day. A good ewe will yield four pounds of washed wool and one lamb per year. On a farm adapted to the purpose, one hundred sheep can be kept as cheaply as ten cows, and with much less labor.

The "blind staggers" in sheep has been cured by injecting diluted carbolic acid into each nostril two or three times. The cud was soon regained, and the usual health of the sheep restored. Physiologists have long noticed that, if nutrition is carried too high, by overfeeding, sterility in the animals is the consequence. Alluding to the loss of sheep by dogs, several farmers remarked that, after losing many, they placed bells on each one of the remainder of the flock, and since have

seldom lost a sheep where several hundred were kept, though all their neighbors had lost many. Half-starved dogs, however, will kill sheep either with or without bells.

Connecticut formerly did a large business in raising first-class horses, but latterly its best horses have been raised in other States. The heavy truck horses are brought from Pennsylvania, large carriage horses from Ohio, and light roadsters from Vermont, Canada, and other places. Horse dealers say Connecticut has been raising the poorest horses of late years of any State in the Union. To regain its former position in this business full-blooded stallions must be used, and better breeding mares. There is a hundred dollars' difference between the value of high-bred colts and ordinary ones, when two or three years old. Farmers have begun to see this, and a very decided improvement is taking place. They pay more attention to the breed of their mares and the selection of stallions, and are more careful of their colts.

Mr. J. G. Stoddard, of Newington Junction, says that, in training colts, *tact* is as necessary as in rearing children. A yearling colt may become accustomed to the locomotive, umbrella, wheelbarrow, and other objects, and after being once convinced by touch or smell that no harm comes from them, he remembers; and all such matters of education tend to make him a safe horse ever after. A colt that was accustomed to run from his stable to the yard through a narrow door one day struck his hip against a door-jamb, and ever after was afraid of doors. Animals that think and remember, as the horse, need great care and precaution in management. He is an intelligent animal, and in proportion as he is well treated will he be subservient to all demands on his labor.

We observe with regret, by a note at the close of the report, that the State Board of Agriculture was abolished by resolution of the general assembly, July 21, 1870. The entire expense of the board during the four years of its existence has been but a little over $13,000, including the cost of 12,000 volumes of their excellent reports that have been distributed throughout the State. In the opinion of those best qualified to judge, Professor Johnson's analyses of the commercial fertilizers found in their markets is alone worth more to the farmers of the State than the whole expense of the board. We have no doubt that a reorganization will soon be effected on a more liberal basis.

There are sixteen county and town societies that appear to be in a flourishing condition.

MASSACHUSETTS.

The Seventeenth Annual Report of the secretary of the Massachusetts Board of Agriculture, Charles L. Flint, makes a volume of six hundred and fifty pages, and gives a comprehensive view of the agriculture of the State. It embraces the report of the committee on contagious diseases among cattle, the discussions and addresses at the public meetings of the board, abstracts of returns from county societies, and essays on various subjects connected with the pursuits of the farmer and fruit-grower.

The financial condition of the State and County societies is very satisfactory, their permanent funds amounting to $272,225 59; their real and personal estate, less their indebtedness, $355,582 33; receipts of the year, $135,245 11; total disbursements, $129,981 31, including $30,734 for premiums and gratuities.

In a discussion on mineral manures, Colonel Wilder remarked that there is nothing so much wanted on the old soils of New England, that have been long under cultivation, as potash. He considered ashes, at 50 cents a bushel, the cheapest manure for any crop. On orchards it has a

particularly beneficial effect. This is shown by the fact that on all our virgin soils, recently burnt over, we get the fairest fruits, the finest vegetables, and the best grain. This was illustrated at the exhibition of the American Pomological Society at Philadelphia, where the fruits from the new State of Kansas attracted universal admiration. He thought that salt, as a manure, should be used with great caution, and that it had no beneficial effect on land near the ocean, where there is naturally an atmosphere saturated with salt.

Mr. Thompson, of Nantucket, stated that on land so poor it would not spindle corn, he had applied coal ashes, two or three inches deep, mixed with a little yellow loam, then plowed and harrowed, and in three years the soil was so much renovated that he cut a ton and a half to the acre of the best clover. In another five-acre field, where he had applied leached ashes liberally, not much advantage was noted the first year, but the next year the benefit was very perceptible, which increased annually five or six years, when the meadow was plowed up. In a part of the field barn-yard manure was used, which ceased to show much effect the third year, while the ashes were effective for many years. A compost of three parts of muck to one of coal ashes was used in alternate strips on another field, by way of experiment, and sown with clover, rolled, but not harrowed. Wherever the compost was spread the clover germinated and developed handsomely, while the strips without the compost were barren. Mr. Thompson found it an object to pay 25 cents a load of 16 bushels for all that were delivered at his farm. The alkaline matter of the ashes neutralizes the acid in peat. On Long Island the farmers send vessels to the State of Maine to bring ashes by the cargo to enrich the famous vegetable gardens that supply the markets of New York. On the light, sandy lands of Nantucket coal ashes harden the soil, and bring in white clover.

Mr. Hyde, president of the Massachusetts Horticultural Society, thought no one could go wrong in the use of wood ashes; he had used them with the most gratifying results, particularly on strawberries. He used peat ashes, chiefly as an absorbent, with the liquid contents of privies and with muck, with great satisfaction. He had not found coal ashes of much benefit on either wet or dry meadows, except in its mechanical operation on soils; as an absorbent it was no better than sand. He agreed with Colonel Wilder that salt is of no use on soils near the ocean, even in the culture of asparagus, a marine plant. Mr. Goodman, of Berkshire County, considered salt beneficial on lands in the interior beyond the influence of the sea air. Mr. Beebe, also of Berkshire, uses from one to three bushels of salt to the acre on oats, potatoes, and wheat, and on grass lands as a top-dressing, sown on the sod with the grain, harrowing in the whole together, and then sows the grass seed on top without stirring the soil. When used on land sown with oats it stiffens the straw, increases the weight, and his oats were six inches higher than the crop standing side by side, with the same cultivation except the application of salt. He said one of the best manures for sandy land is a compost of one bushel of salt and three bushels of marl, which should lie four months under cover; then add five bushels of this compost to a cord of muck. (Professor Mapes's famous recipe.) He tried it fifteen years ago on land that still produces double the quantity of grass that is yielded on adjoining lands not thus manured. He thinks it, also, a great preventive of the rot in potatoes. While speaking of salt, he remarked that great care is requisite in feeding it to animals; he thought that nine-tenths of the animals reported

as dying of murrain are killed by giving them too much salt, particularly young animals.

In discussing the subject of dairy stock, Dr. Loring stated that there were 150,000 cows in the State, and that nearly $2,000,000 worth of milk is annually sold; yet with plenty of good pasture and an increased demand for dairy products, there had been but a slight increase in the number of cows for ten years, which indicated that the most systematic and economical system of producing milk, butter, and cheese has not yet been attained. Sufficient care is not exercised in selecting the cows. For the climate of the Northern States a medium-sized cow is needed; not too large, too coarse, too thin, nor too fine; but compact, firmly set upon her legs, with a lively countenance, and a good straight back. In fine, an animal with a clean, well-shaped head, a luxurious mouth, loose shoulder, straight quarter, broad back, and great depth of carcass, the tail long and the rump level. There should be an increase of the number of cows; 300,000 could be sustained in Massachusetts with profit; the amount of manure would be doubled, and the fields thus made to smile with increased fertility. He considers the feeding of oleaginous food, as cotton-seed, injurious to dairy cows. In the course of three years he has lost thirty out of fifty Ayrshire cows. He said:

> Their udders are made for work, and they are not to be broken down by a trifle. But I found the udders of those cows fed on cotton-seed meal had all got out of condition. One teat would go, then another, and at last I had cows with two teats, cows with one teat, and the value of my herd was gone. They lost their appetite, and it was evident that they had been fed on something that did not agree with them, and that their lacteal system had been ruined. This little delicate organism had been inflamed, was broken up, and was good for nothing. I supposed it was the cotton-seed meal. * * * The nearer you can get to pasture grass for feeding dairy cows, the better. Good water, good light, early-cut hay, roots, and shorts are sufficient for any cow. It is the cheapest food you can get.

The Jersey cattle, (known for many years as Alderneys, as vessels trading at the Channel Islands usually touch at Alderney last, and being reported as from that island, the cows taken on board, though really from the Isle of Jersey, are called Alderneys,) are becoming great favorites as dairy stock. In the eastern part of the State are many herds of the finest animals of this breed.

Colonel Wilder, in his address on the culture of fruits, urges more careful attention to the requirements of different varieties to different soils and treatment. Some fruits are suited to one locality, some to another, and a very few to a great variety of latitudes. Upon the observation and study of these facts depends much of success in fruit culture. Some varieties are adapted to a wide extent of territory, as the Bartlett pear and the Red Astrachan apple, which succeed throughout our country. The thinning of the apple, pear, peach, plum, and grape crop is indispensable for the production of large, fair, and valuable fruits. Such fruits command a higher price and a more ready sale than those not thinned. By thinning our fruit we also prevent the exhaustion of the tree and keep up a regular succession of good fruit. The overbearing of a fruit tree one year almost always occasions barrenness the next. In gathering apples they should be packed when perfectly dry, not bruised nor chafed. The waxy or greasy secretion observed on fruits is a natural provision for the protection of the skin from the effects of moisture and air, and should not be removed even by wiping, for when the skin is deprived of this protection, or is broken by pressure, the oxygen of the air comes in contact with the juices of the fruit and fermentation and decay ensue. Colonel Wilder says:

> Summer and early fall pears should be harvested as soon as they commence ripening on the tree, and be placed in a dark, cool room until ready for use. This process serves

to elaborate the juice and sugar, but if left on the tree until mature, most kinds will become mealy and fibrous. Not so with early apples; a contrary practice should be adopted with them; for instance, the early apples should be allowed to become perfectly ripe before being gathered. So well convinced of this fact are our best cultivators near Boston, that they mulch the ground under the trees with hay or straw, and allow such early varieties as the Early Harvest, Sweet Bough, Red Astrachan, Williams' Favorite, and even Gravenstein to drop from the trees, and gather them daily.

With late varieties, both of the apple and pear, it is best to allow them to remain on the trees as long as possible without injury from frost and gales; but when the foliage has fallen or is destroyed by frost, the functions of the tree are arrested, and no further advantage to the fruit can be derived.

As the flavor of fruits is so very delicate, it is absolutely indispensable to keep them from all decaying substances, either their own or other matter. The aroma of fruit, upon which depends so much of its relish and excellence, is extremely volatile, and the fruit should therefore be excluded from the air as much as possible, only admitting what may be necessary to preserve proper temperature, and for the prevention of too much moisture. No imperfect specimen should be admitted into the room, and all decaying fruit should be removed immediately. The practice of spreading out fruits on shelves, as formerly recommended in this country, and still practiced in Europe, requires too much room and waste, and even in pretty close apartments they lose much of their flavor, and without extraordinary care will become dry and shriveled. The better course, therefore, is to pack in boxes and barrels; and, to avoid the necessity of handling, to pack them immediately from the tree.

In summing up the most important considerations in fruit culture, Colonel Wilder urges the following: Thorough and perfect drainage of the land, either natural or artificial; proper preparation of the soil, clean cultivation, and constant care of orchards; the necessity of excluding grass, grain, and all other crops from orchards, except, perhaps, a few vegetables while the trees are young; the importance of regular manuring of fruit trees, (as well as other crops,) and of applying the manure in the fall, on or near the surface, so that the rain, snow, and frost may prepare and convey its elements to the roots; the importance of thinning the fruit, thereby improving its excellence, increasing its value, and preventing the evil effects of overbearing, which always results in injuring the constitution and shortening the life of the tree; and lastly, clean culture, without destruction of the roots by deep plowing or spading, and constant care and vigilance are indispensable conditions of success.

The following select list of fruits is recommended as adapted to seasons of maturity, and to most sections of the State:

APPLES.—*Summer:* Early Harvest, requires a warm, rich soil; Red Astrachan, Williams' Favorite. *Autumn:* Foundling, Porter, Gravenstein, Mother, Holden Pippin, Hubbardston Nonsuch. *Winter:* Rhode Island Greening, requires a good soil; Baldwin, Roxbury Russet, requires a deep rich soil.

PEARS.—*Standards on pear roots:* Clapp's Favorite, large, should be gathered by the 25th of August; Brandywine, early and productive; Bartlett, succeeds throughout the country; Doyenné Boussock, prolific and profitable; Belle Lucrative, rich, but does not color as well as some; Buffum, very vigorous and productive; Urbaniste, one of the best autumn; Merriam, golden russet, a fine market variety; Onondaga, good for market; Lawrence, a popular winter sort; Beurré d'Anjou, early winter, and the best acquisition of the age; Vicar of Winkfield, hardy, fine tree, superior for cooking, and frequently good for the table. *Dwarfs on pear or quince roots:* Louise Bonne de Jersey; Duchesse d'Angoulême; Urbaniste; Vicar of Winkfield.

GRAPES.—Delaware, small, early, rich, and requires a warm, generous soil; Hartford Prolific, early; Massasoit, (*Rogers's No.* 3,) early; Wilder, (*Rogers's No.* 4;) Concord; Merrimac, (*Rogers's No.* 19,) the last three ripening about September 20.

T. D. Thatcher, in a report on clover as a fertilizer, considers a good clover lay worth as much as five cords of common manure to the acre. To insure a good lay, not less than ten or twelve pounds of seed should be sown to the acre, on land thoroughly prepared for its reception, and well rolled after being sown. Clover not only imparts fertility when plowed under, but its roots divide and break the soil while growing, and render it pulverous as they decay. The thicker the plants, the firmer

and better the herbage; the more abundant the roots, the greater the benefit to the soil, both as regards pulverization and fertility. On wet, low lands, or very light, sandy soils, the endeavor to make clover a fertilizer sufficient to redeem such lands and place them in a good condition for corn or wheat, or even pasturing, would prove a waste of money and labor.

As good roads are closely connected with agriculture and other prominent interests, the legislature appropriated $400 for one or more premiums on the science of road-making, and the best methods of superintending their construction and repair, and authorized the printing of three thousand copies. Three of these essays are printed in the appendix of the report. As a method of economy to the towns, it is found cheaper to have roads well built, and to keep them constantly in high condition, by daily attention, than to undertake their annual repair, as was formerly the custom in New England. In Waltham, for instance, with sixty miles of roads, a few men have been employed for twelve years past, to watch for the beginnings of any wear upon them, and mend a defect when it first appears, instead of waiting till the trouble becomes serious and then setting a large force at work. One man, with a shovel full of broken stone, can prevent what it may require half a dozen men with a team to remedy, after a few months' neglect. It costs that town, to keep its admirable roads in order, and clear of snow-drifts, about $66 a mile. In the adjoining town of Newton, where the roads are kept in incomplete repair, on the old system, the cost is $176 per mile, nearly double, and for very inferior roads. In Waltham the principal streets and roads are well macadamised, and sustain loads of six tons without being cut into ruts. On passing the boundaries of the town, the changed character of other roads, in their ruts, mud, and neglected repairs is painfully evident. The heaviest tax paid by the people of the State is that for keeping up what one of their writers denominates "the worst roads in existence."

NEW YORK.

The twenty-eighth volume of the Transactions of the New York State Agricultural Society (which was not received till after our last report was placed in the hands of the printer) comprises the report of Dr. Carmalt, commissioner for investigating the causes of abortion in cows; several addresses at the State and county fairs; abstracts of the reports of about one hundred town and county farmers' clubs; essays on new American grapes; on salt as a manure, and for domestic purposes; on the solubility of phosphate materials; the construction and heating of dairy-rooms, and the reasons why clover is beneficial as a preparatory crop for wheat. Dr. Carmalt's labors have resulted in overthrowing most of the preconceived theories and conjectures as to the causes of abortion in cows, and he is collecting a fund of information on the treatment of cows by dairy farmers, and the character of the vegetable products of the farms affected by, as well as those free from, the malady. This information is important, though no certain results as to the causes and prevention of the mischief have yet been reached. The importation of thorough-bred stock was large during the year, principally of Jersey cattle, a breed rapidly coming into favor; likewise of Cotswold, Lincoln, and Silesian sheep.

Mr. White, president of Cornell University, thinks it a great mistake that agricultural colleges should be expected to give *primary* instruction in the rudiments of agriculture and the mechanic arts; that is, that in agriculture "they should take young men who never touched a spade;

who do not know wheat from barley; who are too indolent or too proud to go upon a farm—and teach them the A, B, C of farming, the usual method of spading, hoeing, and plowing, just as they might learn it in every field of this broad land. Or that in mechanic arts they should take young men, too indolent or too proud to go into the workshop, and set them at playing with tools, in the hope of teaching them to wield a hammer or to shove a plane." There is no "royal road" to farming. These institutions should take sound, manly, capable young men, where the farms, the shops, and the preliminary schools leave them, and give them back to the country, strong to develop and increase the resources of neighborhoods, States, and nations. The splendid endowments of our leading colleges should not be frittered away on preliminary education, that is better given by farms, shops, public schools, and academies, but should be concentrated for an advanced education, with the best professors, buildings, libraries, models, apparatus, machines, and the best farms and shops. It is not enough to have a professor of agricultural chemistry, or of the mechanic arts, here and there. They should be brought together, with ample educational material of every sort. Resources for primary education should be scattered—but concentrated for advanced studies.

Mr. S. S. Whitman, of Little Falls, thinks farmers lose much money in raising inferior hogs, and recommends that they keep only thorough-bred boars. It is not advisable, however, to raise thorough-breds merely for the butcher. Select the best sows of the common stock, large, even if a little coarse, and cross them with a pedigree boar of good shape, fine bones, and great aptitude to fatten and mature early, such as the Suffolk, Berkshire, Essex, or Yorkshire; and if the young pigs are well fed, no more useful hog for ordinary purposes can be desired. It is absolutely essential at all times to use a thorough-bred boar, but whether of large or of small breed depends on circumstances. For spring pigs, to be fattened in the fall, the small breed will be the most profitable; for pigs to be kept till a year or eighteen months old, the Yorkshire, or some other large breed, may be better. Crossing with a large sow, even of the smallest of the small breeds, (the Prince Albert) will give a hog which will dress four hundred pounds, at a year or fourteen months old.

Dr. S. J. Parker, of Ithaca, details interesting results in hybridizing grapes, by cutting off the anthers of some hardy native grape, and flooding the pistils with pollen from the Black Hamburg, or some other superb foreign grape, from which several fine varieties have already been raised, combining the peculiarities of both parents. He asserts that even the Black Hamburg never dies from cold, but from disease, and says that he has had canes of this grape bear freely after exposure to 18° below zero, F. He suggests that hybrids may be made by intertwining bearing branches of two sorts, so that the pollen of one will fertilize the other; and is confident that ultimately we shall produce scores of grapes as luscious as any now grown in Europe, fitted to our varied climate, and eaten everywhere in our broad domain. At Hammondsport, New York, where grape culture has been so successful, the vines are trained on a low wire trellis, so that the fruit is only from 10 to 18 inches from the ground, just high enough to keep it out of the splash of rain-mud.

Mr. Joseph Harding, of England, in a prize essay, states that the American factory cheese now finds a ready sale, at high prices, among the most fastidious consumers in England, and sells at better rates than English cheese, which has so long monopolized their markets. He urges greater attention to small details, as milk begins to decompose the

moment it leaves the cow, and is easily affected by external influences; and if it comes in contact with the effluvia from gutters, or other noxious places, or even with meat hung in its vicinity, it will at once absorb the taint. This attention is important, as the same milk which is made into inferior cheese can as easily and at the same expense be made to yield a fine article, and with very different pecuniary results.

It appears from Mr. Geddes's essay on salt that, until within a few years, the use of Turk's Island salt had always been required in salting pork for the army. But experiments made under the direction of the War Department dispelled the prejudice that required the use of this salt, and proved that the Onondaga salt, tested in hot climates and for long periods, is quite as good as that made anywhere to keep army or navy pork, and it is now used by the Government. It has also been extensively introduced into the great dairy districts in New York, and has given satisfaction after the severest tests. Even the prejudices of our eastern fishermen, who, for a century, have imported all their salt from the Mediterranean coasts of France, have given way, and salt from Onondaga is fast coming into use with them, with satisfactory results. The salt springs of Onondaga are now capable of supplying 10,000,000 people with salt for every purpose; and in Michigan, the supply of water from their salt springs is practically unlimited, and that, too, where the salt can be rolled directly from the manufactories on board the vessels that navigate the great lakes. An immense bed of rock-salt has also been discovered in Louisiana, and it is so easily worked that the salt can be delivered in New Orleans at $4 a ton, which is a lower price than that of the coarse English salt on shipboard at Liverpool. Relative to the expediency of using salt as a manure, experiments are mentioned with diverse and sometimes opposing results. This is doubtless owing to variations in the quantity used, the manner of using, and the difference in the compositions of the soils on which it has been tried. After weighing all the facts in the case, Mr. Geddes comes to these conclusions:

> Some soils have enough salt in them, and more added does injury. Such lands may be found along the seacoast, and where salt springs appear. Other lands are greatly benefited by light dressings of salt. English farmers "scatter salt over their fields at the rate of two bushels per acre, with good success," and this quantity may be enough. Some men have greatly puzzled themselves over the fact that light dressings are beneficial, while heavy ones do positive injury, and have finally said, as salt in small quantities is known to accelerate the putrefaction of animal substance, and when in larger, to retard it, and thus is useful in assisting the organs of digestion in men and other carnivorous animals, * * * so it may aid in reducing vegetable matter in the soil into food for plants, if applied in small quantities.

Mr. Skinner sowed rather less than half a barrel of coarse salt on an old sod filled with grubs. The salt was soon dissolved by rain. The ground was harrowed and planted with corn, and half a pint of leached ashes was scattered on each hill. The yield of corn was very large, and not a hill was injured by worms.

Mr. Solon Robinson thinks the best lime for farmers comes from oyster-shells, or marl, which is a product of small shells. Limestone clay lands are always productive, as the blue-grass regions of Kentucky and other Western States prove. Their alluvial portions produce wonderful crops of Indian corn, and at some future day, he is confident, will give a great yield of sugar beets, the culture of which will prove a staple industry of American farmers, as it is in France and Germany. Decomposed argillaceous rocks, particularly when micaceous, make good soil for grapes, as the mica affords potash, which grapes must have. It is also a prime necessity for growing wheat, as all good farmers know, and

wheat, of all things grown for human food, is the most important. Properly cultivated fields never become exhausted, if all that is taken from them in grain, grass, or roots, be restored to them in excrementitious manures. The tobacco and cotton fields of the South are not the only portions of the land that have been abused by wasteful culture.

Farmers are urged to plant forest trees for timber and shelter, as well as shade trees by the roadside. Every tree set out to ornament a homestead is a profitable investment, increasing the salable value of a farm.

The receipts of the State Agricultural Society were $47,341 35; expenses, $29,663 39; entries, 2,662. Receipts of the American Institute, $24,811 98; expenses, $14,734 89; balance in both cases invested in United States bonds.

OHIO.

The twenty-fourth annual report of the Ohio State Board of Agriculture, with its usual statistical matter, comprises also the proceedings of the Ohio Horticultural Society, and essays on cheese factories, flax husbandry, the Colorado potato bug, hog feeding and pork packing, road making, ergot as affecting the dairy interest, parturient fever in cows, several agricultural experiments, (the latter abridged from the Journal of the Royal Agricultural Society,) and a lecture delivered before a farmers' club in England on the supposed deterioration of the soil of Great Britain. These articles give a permanent value to the volume.

The balance and receipts of the board for the last year were $48,448 19; expenditures, $24,502 18; leaving $23,946 01, invested chiefly in United States bonds. About 80,000 admission tickets were sold at the last State fair. The number of entries was 4,100, an increase of 581 over that of the previous year.

The production of cheese in Ohio the past year was 22,266,927 pounds, of which nearly 3,000,000 pounds were from Ashtabula County This and the other Counties on the Reserve have hitherto enjoyed a monopoly of the dairy business of the State, but it is rapidly spreading. In Geauga County, also on the Reserve, there are twenty-five cheese factories, which use the milk of nearly 15,000 cows. The average yearly receipts of the best dairies during the last four years have been fully $60 per cow, and of dairies generally rather more than $50. A farm of one hundred acres, allowing twenty-five acres for woods, orchard, garden, buildings, and yard, will keep handsomely eighteen cows, and the receipts would thus amount to $900. Besides, from the farm would be obtained garden vegetables, fruit, milk, butter, meat, and wood sufficient for family consumption. One man could do all the needed work on the one hundred acres, with the exception of milking, and in this the assistance of only one person would be needed, usually one of his own children, or his wife. In five townships on the Reserve there are 8,600 cows, which give the following result:

8,600 cows, 350 pounds of cheese per cow	3,010,000 pounds.
30 pounds of butter per cow	258,000 pounds.

These amounts of butter and cheese are equal to 35,346,000 pounds of milk.

3,010,000 pounds of cheese, at 15 cents per pound	$451,500
258,000 pounds of butter, at 30 cents per pound	77,400
Skins and whey, $2 per head	17,200
	546,100

There were manufactured, bought, and shipped from Solon, Ohio, last year, 2,821,263 pounds of cheese, all handled by three firms in that township.

There are ninety-seven cheese factories reported in thirteen counties, chiefly on the Reserve. As an evidence of the prosperity of dairymen, it is mentioned that in one township on the Reserve nine-tenths of the income tax is paid by them, although they occupy less than half the land. Their profits are also more certain and uniform than in other branches of agriculture. If a severe drought decreases the yield of milk, it also enhances the price; and the difference between the product of cheese in the best and in the poorest season is nowhere so great as in the case of grain, where one sometimes fails to realize the cost of seed and labor. The profits of dairying may be largely increased also by improving the stock, and breeding with special reference to milking qualities.

The reports of the County societies are generally encouraging. Several new kinds of wheat and oats have been distributed by the Department of Agriculture, of which the Tappahannock wheat is considered earlier than any other variety. One quart sent to an intelligent farmer in Auglaize County, a few years since, had increased to about two hundred bushels the past season, and was all sold at a good price. From one quart of oats distributed by the Department, Mr. Kinney, of the board of managers of the Wayne County Society, raised one hundred and seventy pounds.

Horses of Canadian, English, French, and Norman breeds are raised in several Counties for the Eastern markets. Assessors' returns show an aggregate of over 700,000 horses in the State, and but 22,057 mules.

The apple crop in Lorain County was considered worth more than half a million of dollars last year, upwards of 80,000 barrels having been shipped. For the last two years blight and insects have committed great ravages. It is estimated that this County alone loses $50,000 annually by insects, and it is proposed to introduce the English sparrow extensively to destroy the insects and their larvæ. There are about two hundred and fifty acres devoted to vineyards in this County, from which were sold about two hundred and fifty tons of grapes, which brought the producer an average of 6 cents a pound; about 3,000 gallons of wine were also made. The rot and mildew are becoming troublesome.

Mr. J. M. Allen says that the annual production of flax-seed in this country in 1850, as shown by the census, was 562,000 bushels, and in 1860 it was 611,000 bushels, an increase of only about 50,000 bushels in that decade—a period when the manufacture of tow from tangled flax-straw was almost entirely unknown; while, with the subsequent introduction of flax machinery, the yearly product is now believed to amount to not less than 2,500,000 bushels. The flax crop of last year was equivalent to 75,000,000 pounds of fiber. The average product of seed throughout the State is six and one-third bushels per acre, with five hundred to eight hundred pounds of straw. Compared with grain crops, flax in many localities is a much better crop for farmers. If all the fiber were worked up into bagging it would cover a cotton crop of 3,000,000 bales. Hence, Mr. Allen concludes that flax husbandry, having become an important branch of agricultural industry throughout the Northwest, with much capital directed to its development, should be sustained by the Government against the inferior foreign jute bagging now being urged upon the cotton raisers, and which will drive our linen bagging from the market should tariff protection be withdrawn. It is stated that the tensile strength of flax is double that of East India jute. Not one-fifth of the American flax fiber has yet been utilized, although there are fourteen mills in the West engaged in making gunny bags and bagging for cotton.

Mr. Joseph Sullivant, in an article on hog-feeding and pork-packing, states, as the result of many experiments, that cotton-cake, beans, peas, and linseed-cake contain more of flesh-givers than corn, and might be fed very advantageously to young and growing animals; yet, upon the whole, Indian corn stands preëminent as the cheapest food material accessible to farmers. Estimating the return of pork from a bushel of raw corn at nine pounds, his experiments prove that corn ground into meal increases in value about 33 per cent. over that of corn fed in the ear; and that thoroughly steaming and cooking the whole corn raises its value to but little less than that of cooked meal, which he estimates at 66 per cent. over that of raw corn fed in the ear. He adds:

It is true that grinding, steaming, or cooking the corn can in nowise add a single atom to the elements already existing; it raises its value only by rendering the whole nutritive matter available by making it more soluble and of easier digestion, so that the maximum of nutrition is more readily and certainly obtained.

I conclude that nine pounds of pork from a bushel of raw corn fed in the ear, twelve pounds from raw meal, thirteen and a half from boiled corn, and sixteen and a half from cooked meal, are no more than a moderate average to be realized from a bushel of corn under ordinary circumstances of weather, with dry and clean feeding-pens. All this is within the amounts we have shown to be probable and attainable upon our chemical basis.

In conclusion, Mr. Sullivant says:

If I have proved anything, it is that it is possible and comparatively easy to get 50 per cent. more for corn than we now do for all the millions of bushels fed to hogs in the process of pork-making. Sustaining in this industry alone a loss of millions of dollars annually, the question of how much pork in a bushel of corn is *not* an insignificant one.

It strikes me that the different State agricultural societies could engage in no more beneficial work than to arrest the enormous losses of our wasteful feeding processes, by the dissemination of correct information; and, by a series of well-conducted experiments, lend their powerful aid to elucidate so important a subject.

An account is given of the great sale of Short-horn cattle of Mr. Daniel McMillan, near Xenia, which occurred on the 8th of June, a record of which is found in "Current Facts in Agriculture," page 144. The product of this sale exceeded $64,000, the average being somewhat over $900 each. In comparing with English prices, it is stated that the great English breeder, Charles Colling, sold out his herd of forty-seven animals, in 1810, during the continental wars and general inflation of prices. One bull, Comet, sold for 1,000 guineas; the cow Lily for 410 guineas. The entire herd averaged about $733 each. His brother, Robert, sold his herd of sixty-one animals, in 1818, for £7,853, averaging about $643 each. The executors of the late English breeder, Thomas Bates, sold his stock of sixty-eight animals, of all classes in the herd, which brought only $22,000, an average of $323 53 each, though several of the choicest brought upwards of $1,000 each, and it was a time of great depression in agricultural values. After the death of Lord Ducie, a careful and judicious breeder, who had purchased the best of Mr. Bates's stock, his entire herd of forty-nine cows and heifers was sold at an average of $678 each; his thirteen bulls averaging $930 each. Several of the Duchess and Oxford tribes were brought to the United States, where they have been successfully bred, and many disposed of at private sale at prices hitherto unprecedented in the annals of Short-horn breeding—$3,000, $5,000, and even $7,000 each! No public sale of these tribes of cattle has yet taken place.

Notwithstanding the general complaint of rot and mildew in grapes, particularly in the Catawba, the acreage of vineyards has increased from 7,574 to 10,446 the past year, and the product of wine from 143,767 to 155,045 gallons. Mr. Flagg, in a letter on the sulphur cure for mildew, is confident that as in Europe sulphur cures the *oidium*, with all

its train of symptoms, and drainage suppresses *charbon* and all its train, so in Ohio, sulphur and drainage have cured this fungus disease the past year and rendered practically harmless the black sickness of the grapes. The best cultivators urge the importance of thinning out the fruit, over-cropping being a common fault in the Ohio vineyards. The orchard products of the State are estimated at $7,000,000 annually. The shipments of strawberries from Cincinnati in one week, in June, reached 18,200 bushels, or more than 455 tons, equal to 45 car loads.

There is a general complaint that the crops of apples are both decreasing and deteriorating, which is ascribed to several causes, as, now and then, severe winters, killing many trees outright and rendering others feeble and sickly for years; severe droughts; undrained and badly-prepared land before planting, with poor or no cultivation afterward; starvation, by cropping the soil, when naturally poor, with no manuring; bad pruning; and borers. The evils affecting fruit generally are attributable to the great increase of insect enemies, which will not be mitigated as long as an indiscriminate slaughter of small insectivorous birds is allowed. The curculio now attacks apples as well as stone-fruits. Strong hardware paper, wound tightly around the base of the tree, is recommended as a good protection against the peach tree worm.

MICHIGAN.

The eighth annual report of the Secretary of the State Board of Agriculture comprises not only the usual statistics and proceedings of the board, but also reports from the county societies; discussions of the Western Lake Shore Horticultural Association, of more than ordinary interest, on the adaptability of that part of the State to the production of fruit; essays on wheat culture, grasses, cheese dairying; experiments in fattening swine, and the Colorado potato bug; exhaustive articles on Short-horn cattle and long-wooled sheep, by the secretary, Sanford Howard, and an interesting article on European agriculture, with notes by Mr. Howard.

The receipts of the board last year were $70, 752 17; disbursements, $66, 672 69. Receipts of the State Agricultural Society, $22, 863 87; disbursements, $22, 954 11, including some extra investments. The number of students at the State Agricultural College was 69. The superintendent of the college farm reports various experiments in fattening stock, the application of manures and special fertilizers, and with varieties of grain. The Excelsior oats yielded at the rate of 60.6 bushels per acre, weighing 37.5 pounds per bushel; the Somerset oats, 94.2 bushels, weighing 31 pounds; the White Schonen oats, 62.3 bushels, weighing 37.5 pounds; and the Black Swedish oats, 66.2 bushels, weighing 30.6 pounds. These four varieties were introduced and distributed by the Department of Agriculture. The Prince Edward's Island oats yielded 63.2 bushels, weighing 34.7 pounds; the Brooks oats, 68.6 bushels, weighing 31 pounds; the Norway oats, 50.3 bushels, weighing 28 pounds; and the Surprise oats, 38.3 bushels, weighing 36.2 pounds.

The ravages of the potato bug have been less destructive than usual, the chief causes of which were the two or three warm weeks in April and May that brought out large numbers before their usual time, which were destroyed by cold and starvation in the raw and changeable weather that followed; farmers also were vigilant in picking and destroying the old beetles as fast as they appeared, so that, after all, there was raised the largest and best matured crop of potatoes ever produced in the State. The potato bug, the grasshopper, rose bug, and army

worm are largely under the influence of atmospheric changes and conditions, which often prevent their doing much harm.

Mr. Geddes, in an elaborate article on the culture of winter wheat, after allowing for all drawbacks, perils from insects, &c., comes to the conclusion that it will be profitable as a leading crop as long as people prefer wheat bread to any other, although from various causes it may sometimes be unremunerative, like all other crops and branches of business. With good wheat land a farmer can combine with this crop the raising of other cereals, dairying, stock-raising, or wool-growing, as circumstances may make most judicious, thus availing himself of all the advantages of mixed agriculture.

Cheese factories are increasing in various parts of the State. In Lenawee County 331,000 pounds of cheese were made from 3,140,660 pounds of milk, averaging one pound of cheese from 9.49 pounds of milk. It was sold for $52,421 23, or at $15 83 per 100 pounds; the total cost of manufacture and selling was $2 82 per 100 pounds. There are fifteen factories in this County alone, using the milk of upwards of 4,000 cows. Other factories in the State are working with satisfactory results. Heretofore Michigan has never produced cheese enough for home consumption, but with the number of new factories going into operation, it is probable that the State will soon make a surplus for exportation.

At the discussions of the Lake Shore Horticultural Association, Mr. E. P. Powell, of Adrian, a successful cultivator of pears, recommended mulching pear trees as a preventive of blight, and as advantageous in other respects. He sometimes uses long manure, though preferring only grass. His soil is a clay underdrained. A few years after planting his orchard he ceases plowing the land, and simply cuts the grass and spreads it about the trees. No strength is taken from the land except what is gathered in the fruit, and this is replaced four-fold in mulching. No stimulus is given to hasten the growth of the trees, and the wood is consequently strong, compact, and ripe each year. He considers the Flemish Beauty, Belle Lucrative, Louise Bonne de Jersey, Lawrence, Seckel, White Doyenne, Onondago, Beurré d'Anjou, Bartlett, Howell, and Tyson, the surest bearers. The best keepers, and those he finds most profitable, are the Buffum, White Doyenne, Beurré Clairgeau, Seckel, Sheldon, Onondaga, and Beurré d'Anjou. For winter pears he prefers the Lawrence to the Vicar of Winkfield, or even to the Nelis. The Buffum is highly esteemed, has many points of excellence, and occupies but little space, being nearly as erect in growth as a Lombardy poplar.

Mr. H. Pennoyer, another successful cultivator, sets his trees without manure or anything to enrich the soil; lets the grass grow around the trees; uses the knife freely, so as to bring the tree into proper shape and proportion. Pear trees, he holds, must not be stimulated; high manuring forces an unnatural growth, winter kills the soft wood, and blight finally finishes the tree. The peach crop has become a remunerative one; the soil, as well as the protection received from the proximity of large bodies of fresh water, being favorable; high table-land is preferable; one man sells his crop from an orchard of twelve acres nearly surrounded by water at $8,000 to $12,000 per annum; the east side of the water is the best, particularly where the west wind sweeps over the water. The fruit trade of Southern Michigan is very large; the shipments of peaches from St. Joseph to Chicago last year exceeding 700,000 baskets and boxes, besides nearly 100,000 bushels of other fruit, the whole estimated to be worth $1,000,000.

The article on European agriculture, with notes by Sanford Howard,

is filled with details on the production of beet sugar, and is well worthy attention. In France, farming without this adjunct is thought a slow business. As an instance of this mixed agriculture, a farmer at Lens, fifty miles from Calais, has 500 acres in beet root, all on the ridge, without a single black spot in any part. He raises eighteen tons per acre; keeps thirty horses and eighty working oxen; has a sugar factory on his farm, and fattens three hundred to four hundred cattle annually on the pulp from his sugar factory. Pigs thrive on it when cooked, and sheep eat it raw. He adopts the English "box" system in fattening his cattle, keeping them in darkness; they are then less troubled with flies, eat better, and are sooner ready for the butcher than when kept in daylight. Near Valenciennes the country is covered with sugar factories; the average size of the farms is 30 to 40 acres, though there are some of 400 to 600 acres. About half of the land is cropped with sugar-beet, the remainder with wheat, clover, and lucern for fodder; guano is falling into disuse, not producing so good sugar-beet as oil cake, which is now applied to the land as manure. In these sugar districts land has advanced to £100 per acre. The growth of wheat in this district before the production of beet sugar was only 976,000 bushels, the number of oxen, 700; since the introduction of the sugar manufacture the growth of wheat has been 1,168,000 bushels, and the number of oxen 11,500. In Southern France a very different state of things exists; there are to be seen many large estates of 5,000 acres, divided into farms of 2 acres up to 500, and rented at 5*s.* to 8*s.* an acre; rye is the chief crop. Wages are low, and the condition of the laborers is deplorable. The team-men sleep with the cattle, two in a bed, or rather in a box, on a sack of straw, a rude floor being put up at one end of the shed, and they may be said to be nearly in a state of slavery. Their hours of labor are from 4 a. m. to 8 p. m. in summer, and till noon on Sundays; their wages being but 1*s.* 8*d.* per day, without perquisites, for these long hours. Thus ground down, it is no wonder that the peasantry are crowding to the cities. To compensate for this depopulation of the rural districts, boys are sent from the reformatories and employed in farming till their turn comes for the dreaded conscription. The reformatories are called agricultural colonies. (In Austria the condition of farm laborers is still worse.) A marked improvement is taking place in the live-stock on French farms, and the best breeds of cattle, sheep, and pigs are freely imported. The government has shown a fostering care in importing improved breeds of riding, draught, and carriage horses. Horse-breeding establishments, termed *haras*, have been conducted by the state for many years, and for a trifling fee all farmers can obtain the use of the best stallions at these establishments. Stallions are also sent from these *haras* to various districts of the country, and the government also grants a handsome premium to the owner of a good stallion approved by the official inspector. The draught horses have been greatly improved; the "Percherons," particularly, have been brought to high perfection. The French maintain that the English, though good judges of horse-flesh, are too careless about their horses' feet.

Attention is called to the importance of irrigation, which has changed the face of the country in many parts of Europe; and in Egypt, with very primitive pumps, worked by a mule, bullock, or a couple of donkeys, sufficient water is raised to irrigate 30, 40, or 50 acres, which then produce large crops of a kind of clover called "Burseem." In Lombardy, with an area of 6,000,000 acres, more than a million acres are artificially irrigated, and upwards of three thousand miles of canals have been cut, besides a vast extent of small arteries belonging to private individuals;

and the main canals for navigation are always constructed with a view to a comprehensive plan of irrigating the country. Switzerland also is full of devices for catching the water on the hill-sides and spreading it on the green slopes; it is then again arrested on its way to the valley, and turned over the meadows and fields of maize; every little stream of water is thus utilized. In Bedford, England, the growth of Italian rye-grass by the town sewage is a most complete success; six crops were raised last year, realizing £20 per acre. The grass in these irrigated fields is perennial. As the cultivation of cereals and root-crops has been carried to a high degree of perfection by the best English farmers, their next great step in improvement must be irrigation. Along their valleys water for irrigating scores of acres is to be obtained in abundance at a few feet below the surface, by a centrifugal or chain-pump, worked by a horse or an engine. In France irrigation has enabled farmers in some districts to keep double the number of cattle and sheep, as well as to raise one-third more corn. There the rivers and running water are not under the control of private individuals, as in England. The water belongs to the owner of the land only through which it flows during its transit; when it passes his boundary he has no further control over it. As long ago as 1669 Louis XIV abolished the feudal rights of the proprietors in rivers, the ownership thereof being reserved by the state.

WISCONSIN.

In the eighth volume of reports of the Wisconsin State Agricultural Society (1869) are embodied the transactions of the State Horticultural Society and tabular abstracts of the reports of the county societies. It is the fourth volume that has been edited by Dr. Hoyt, and contains more articles of practical value and interest than any of its predecessors. His own report, as secretary, extending over one hundred pages, gives a comprehensive view of the character of the past season, and the principal crops of the State, as well as suggestions upon its mining interests, commercial development, public improvement, immigration, agricultural education, &c. There are also several valuable articles by other writers.

The farming interest suffered considerably from the general failure of hops and the low price of wool; besides, in consequence of the cold weather of March and April corn was late in being planted, affecting the crop; the abundance of rain through the summer was favorable to the potato crop, inducing a yield of 300 to 500 bushels per acre, and protecting it, in a great degree, from the ravages of the potato bug. The fruit crop was one of the finest ever raised in the State. The yield of wheat was enormous, the most careful estimates ranging it between 20,000,000 and 25,000,000 bushels, at an estimated average of 13.3 bushels per acre.

The Tappahannock and Arnautka wheats, introduced and distributed by the Department of Agriculture, gave good satisfaction, though the former is better adapted to a more southern latitude. The latter, from Russia, promises well, and under reasonably favorable circumstances gives a bountiful yield; it is a bearded wheat, with remarkably large heads, and a very large, handsome berry, and on new lands it is thought it will yield double if not treble the average of the ordinary sorts cultivated in the State. More attention is urged to those inexorable laws of nature that demand a reinforcement of the soil by the careful return to it of the necessary elements of which it has been deprived by successive years of reckless cultivation, by the burning of straw, and the laborious moving of barns to escape what was formerly considered the nuisance

of manure heaps. The oat crop was estimated to be 25 per cent. larger than that of the previous year, with an average yield of 36.2 bushels per acre; the Excelsior and several other new varieties were favorably reported on by all who tried them. The question of sugar-beet culture is amply discussed, and, as this root succeeds well in Wisconsin, it is thought the business deserves attention, if it proves remunerative in any part of the Union.

The culture of rape was introduced at Fond du Lac a dozen years ago by General Hamilton for the extraction of the oil. He has raised 3,000 bushels in some years. At first it was manufactured into a crude oil; but he has invented a process by which an excellent refined oil is prepared, equal to any in the market, and arrangements have been made for an annual crop of 25,000 bushels of this seed. It has many advantages as a farm crop, is of easy culture, and the time of seeding—June 10 to June 25—is convenient. The expense for seed is trifling, say two quarts per acre, at a cost of 15 to 20 cents. In case a crop of grain gives indications of failure, it can be turned under in season for raising a crop of rape in its place, which is subject to no disease or insect enemy. Its broad leaves shade the soil and stifle any weeds that may spring up after it gets fully established, and it prepares the soil admirably for winter wheat; it requires no labor during its growth, and may be cut with a cradle-scythe or mower, and harvested at a most convenient time, in the first half of September, after the summer harvests are out of the way, and before the corn and potato harvest begins. It has proved a profitable crop hitherto; the price ranging from $2 to $2 75 per bushel. One bushel yields about two gallons of oil, superior to the best lard or sperm as an illuminating oil, besides being a good lubricator, and enduring an intense degree of cold before solidifying. The only conditions unfavorable to the entire success of rape as a general farm crop are, that it will not succeed on foul land, where it would be choked out by weeds in its early growth, and that it must be harvested just as the pods are turning from green to yellow or much of the seed will be lost. The mills at Fond du Lac are of sufficient capacity to work up 100,000 bushels of the seed, and the culture of rape must rapidly extend as its advantages become known.

The dairy business of the State has had a large development the past year; about fifty cheese factories have been established already, and the number is constantly increasing. Sufficient attention has not been paid to the breeds of cattle. But few Ayrshires are found in the State, although considered the best milkers.

The mining interests have received increased attention, and experiments show that the peculiar iron ore of Dodge County is in much greater quantity than heretofore supposed, and, when used with the softer iron of Lake Superior and Missouri, its remarkable hardness proves of great value both for working into steel and for making rails. It is stated that—

> In 1868 some cheap English rails were laid on the St. Paul track, and in three months some of them were in the mill to be rerolled, while rails from the Milwaukee mill, [made from a combination of these two kinds of iron,] after one and a half year's wear in the same place, are now as perfect, to all appearance, as on the day when they were first put down. This is the difference between good and poor iron rails.

The County agricultural societies have had a prosperous year. These local organizations are doing much good by stimulating general industry, correcting stereotyped errors of practice, diffusing knowledge, and elevating the profession. The State society has had the most prosperous year since its organization, and its last exhibition was the largest and most complete in all its departments; number of entries, 3,524; receipts, $12,711 31; expenses, $12,032 54.

Mr. D. S. Curtiss, in a brief article, urges the keeping and feeding of all stock in yards or stables, on the "soiling" system. Animals thus reared are tamer and more approachable at all times, and are consequently more salable at better prices, whether horses, oxen, cows, or colts. Being handled daily from infancy, the dangers and difficulties of breaking colts, steers, and heifers are avoided; they are secure from many accidents incident to roaming, and require less food to sustain the same conditions of flesh, milk, or toil; expense is saved in fencing; and, by the mode of cropping required, lands produce larger yields annually, and, liberally manured, will yield much more in bulk and a better quality of feed, when this crop is frequently gathered during the season, than if left to grow until ripe.

Mr. N. J. Coleman, in a lecture before the Illinois Industrial University, on breeding horses, (copied into the Wisconsin report,) pleads for kinder and more judicious treatment of these noble animals. Their stables are frequently too close, with too little light and air; the horse has lungs, and consumes a great deal of oxygen; he is often confined in a close stall, which hardly permits him to lie down; he requires abundance of air and light, dark stables being the cause of diseased eyes in many horses. Stables require windows as well as houses. Brood mares (of which the lecturer keeps forty) should be worked or exercised a little every day; after foaling the work should be very moderate. They require comfortable stables, and they and their colts should be frequently handled; otherwise the colt may be as wild as a deer and not easily controlled at breaking time; colts thus handled from the first are very easily broken. The horse has more intelligence than he is credited for; he can see and hear better than a man, and smell and feel just as well. These facts should be borne in mind in taming him; convince him that you are his friend, and will not hurt him; approach him by degrees; let him smell of your whip and bridle; put on his bridle, and when that is in your hand you are his master, and in ten minutes he will lie down completely your slave. With a few lessons of this kind he will know his place, and obey your voice.

Mr. Jonathan Periam, in a lecture before the same institution, recommends a more general attention to the culture of root crops, both for the table and for stock. Too many farmers are content to live for three-fourths of the year on bread and meat, with a scanty and precarious supply of vegetables, when fifty or one hundred dollars expended in seed and labor upon a single acre would produce more healthful and palatable sustenance than double the amount spent in pork, flour, and doctors' bills, besides the enhanced pleasure produced by a table laden with various vegetable products. For stock, four bushels of carrots are as good for feeding as one bushel of corn meal; their chief value, however, is in feeding with grain, from their peculiar pectine and their action on the digestive organs, which enable cattle more readily to assimilate their food. Half an acre in beets should produce seven hundred bushels; the mature leaves, stripped off from time to time, will feed a cow at night and four hogs principally during the summer and fall, and give four bushels per day for feeding for six months in the year—enough to fatten one cow, and feed another for milk. One-fourth of an acre of parsnips will fatten four hogs, besides feeding four more growing ones until the next spring. Even the rich soil of the West, as now cultivated, does not produce of wheat and other cereals half as much per acre as is grown by English farmers, under the system of root culture in that country, with its attendant necessity, deep plowing. To keep up the fertility of the West, more mixed husbandry is requisite;

and to carry its full maximum of stock, more attention must be paid to growing root crops. Some counties in Illinois, formerly noted for their fine stock, are now dependent upon Texas and the Red River countries for the steers they fatten.

In the discussions of the State Horticultural Society the curious fact was mentioned by Dr. I. A. Lapham that many of the beautiful native plants in his collection, (dried,) formerly common, are now scarcely to be found in the State, having been driven out by the May-weed, mullen, thistles, and other foreign weeds, which have taken their places. The time is near at hand when his collection will afford the only evidence of the former existence of many native plants in certain counties of the State.

Peaches are an uncertain crop in Wisconsin, though many cultivators keep a few trees in their grounds. It is noticed that whenever the thermometer falls to 16° below zero the peach buds are surely killed, though the trees are not; they will bear whenever a winter is passed in which the thermometer does not reach that point. The prairie soil is frequently too rich for orchards, preventing a mature growth of wood; the driest and leanest places, with an elevated, cool aspect, should be selected for the apple and such other fruits as are apt to suffer from excess of food in the soil, the cold winds of autumn and winter inducing early maturity of the wood. Such locations are numerous. Screens and belts of evergreens are recommended. Wherever they have been planted in Illinois a marked amelioration of the severity of the winter is perceptible.

Favorable results have been realized from the improved Siberian crab apple; many seedlings of great promise have been raised from seeds of this apple sent from Vermont twenty years ago. Of these seedlings the Marengo, Chicago, Coral, Winter Gem, and Kishwaukee stand high for their flavor and keeping qualities. Much is hoped from the introduction of the new Russian apples, of which several sorts were introduced by private enterprise a few years ago. Two hundred and forty varieties were also imported by the Department of Agriculture, this season, of which grafts have been freely disseminated to horticultural associations and nurserymen, particularly in the Northwest.

ILLINOIS.

The seventh biennial volume of Transactions of the Illinois State Agricultural Society, edited by J. P. Reynolds, secretary of the society, is filled with facts of permanent interest pertaining to the various departments of industry and the agriculture of Illinois. Besides the usual statistics and reports it comprises the proceedings of the State Horticultural Society; an elaborate report by the editor, as State commissioner to the late Paris exposition; the proceedings of the American Convention on Texas fever; essays on Climatology; on Hedges; on Manufactures in Illinois, and details of the culture of various crops in the State.

The annual fairs of this society have been uniformly successful; the receipts of the last year were $24,096 92; disbursements, $20,191 92.

The custom of holding large tracts of land, of five hundred acres up to ten thousand or more, in some parts of the State, is deprecated, as resulting in sparse settlements, few schools and churches, and neglect of all the small essentials of society as well as of agriculture. A proper system of drainage, both as a sanitary measure and as a means of increasing the agricultural wealth of the State, it is suggested, should receive encouragement and assistance from the State, as is the case in England.

The report on the Texas or splenic fever extends over twenty pages; and, after giving many facts as well as theories, which cover the whole range of speculation on this subject, the commissioners come to the following conclusions, which they assume as proved by their observations, though they state that the second and third points may bear further discussion:

1. That isolation of native stock from Texas herds is imperatively demanded during the hot summer months.

2. That one day's contact, or the crossing of the trail of the Texas herds by native cattle, does not infect the native stock, but continuous contact and *grazing* after them is necessary to produce the disease.

3. The native cattle do not contract the disease by being fed with the Texans in dry lots.

4. That the disease is not disseminated by Texas cattle that have been *wintered* in Arkansas, Kansas, Missouri, Illinois, or Iowa, nor has the disease been known to prevail after the autumnal rains and frosts.

The trade in Texas cattle is one of vast importance, not only to Illinois but to the whole country. Texas wants a market for her untold thousands of cattle, and the Western States want this stock to graze their millions of acres of rich native grasses, and to give them a market for their millions of bushels of surplus corn. As a means of preventing the Texas fever, stock-growers are advised to keep a barrel of heavy coal oil, which has from 8 to 12 per cent. of carbolic acid; also a quart of liquid carbolic acid, which contains 90 per cent. of pure acid; the latter only is soluble in water. The heavy oil should be sprinkled on the floors of the barns, and especially on the droppings, as fast as made. The wood-work of the stalls should be covered also with the liquid substance, spread on by a common whitewash brush, and the stock be kept isolated. No strange animal should be allowed to come on the place, or have access to running water visited by other animals. The dung and urine of sick animals are the chief means of propagating the contagion; it is often diffused even by the dung which adheres to the shoes of attendants.

Western sheep farmers are urged to pay greater attention to root crops, which can be grown freely throughout the West and which would materially improve the luster of the wool. A practical sheep farmer says, paradoxical as it may seem, "if sheep are fed with all the roots they can eat, they will consume double the quantity of corn and put on three times the weight they will do with corn alone." They should be pastured on tame grasses, the higher and more rolling the ground the better. No breed can be kept on prairie grass without becoming thin and worthless. Many failures in this business might have been avoided if this fact had been recognized. The "bush sheep," as those are called which feed on this grass, can be distinguished in the pens at Chicago almost at a glance; and the character of the country and the extent to which tame grass abounds therein, are indicated by the sheep that are driven from it.

Mr. Meehan, in an essay on the diseases of the pear, says debility is the cause of much of the trouble; and this want of vigor is produced by excessive summer and root pruning, which so weakens the wood-producing principle as to induce inflorescence, according the well-known law that nature always makes an effort to reproduce the plant, in proportion to its danger of death. When pear trees produce flowers and no fruit, and the blossoms have had no external injury, it may be safely assumed that the soil is deficient in nutritive elements, that too much summer pruning has been done, or too many surface roots destroyed by a persistent stirring of the soil. Pears cannot be grown to great perfection

except in rich and generous soils. Root crops cannot be raised between the trees without breaking up the ground, which destroys their surface roots, the most valuable of all roots. The best method is to sow down with grass, and manure the surface two or three times a year; the grass roots will never run deep, nor exhaust the soil. Twice as many trees can thus be grown on ground where root crops are not grown; and, if too thick, after twenty years' growth, they can be thinned out. Any one will notice the comparative freedom from debility of trees grown for years in grass, over those grown in constantly-stirred soil. Old pear trees in Mr. Meehan's garden, eight to nine feet in circumference, always bear when they have any flowers at all, always have healthy foliage, always set most of their blossoms, and drop only fruit punctured by insects, enough being always left to produce plentifully; while anywhere in soils with regularly-stirred surfaces will be seen innumerable flowers with little fruit, and with those which do set great numbers are found afterward upon the ground, having fallen off from no other cause than sheer inability in the weakened vital principle to maintain them. Leaf blight and innumerable diseases follow excessively weakened vitality; and though fire-blight, cracking, and other diseases are the means of destruction to many thousands of bushels of pears annually, debility destroys its tens of thousands.

Mr. W. P. Pierson, of Onarga, in an article on the philosophy of under-draining, says that thought, observation, and recent experiments have brought him to the conclusion that—

> The job of finishing up this world can never be completed until a considerable portion of it is well under-drained; and I do not know but I am safe in saying, until it is well tile-drained. Very certain it is that there are immense and untold resources in air and earth, all intended for the benefit of the human race, that can never be made available for the purposes for which they were intended until a vast amount of ditching is done. Nature has already provided, on a most magnificent scale, for the under-draining of extensive tracts of country; but the richer, the better, the greater portions of earth's surface can never be drained by any channels now existing, or that nature ever can or will provide. This is a task that is assigned to man.

Mr. Pierson says the fertile soil of Illinois rests generally on a tight subsoil, so that, one season with another, a large portion of it is saturated with water six to eight months in the year. What is not saturated is damp and cold, from the presence of stagnant water in the tight subsoil. Hence it is that, under the present system of cultivation, not one foot in five of this unrivaled soil can ever be made practically available for the purposes of agriculture; and where only fifteen, twenty, or thirty bushels of corn are grown, sixty, eighty, and one hundred bushels could be raised with less labor and more certainty. Here, too, is the true source of many of the diseases that sweep through orchards and vineyards, blasting the hopes of the cultivator. Relief to these drawbacks, to a large extent, will be found in the adoption and execution, as far as time and means will permit, of a thorough system of tile-draining in conjunction with deep and thorough culture. Mr. Pierson, in conclusion, says:

> Draw off the cold and stagnant waters; check the immense draught from the warmth of the soil by evaporation; set in motion the bright steel clipper, the roller, the harrow, the cultivator, and the subsoiler; send the richly-laden rain-water, the warm, well-freighted atmosphere, and the life-giving dew coursing down through the soil to the utmost depths to which vegetation can penetrate; let in every element from the surface that will hasten the chemical decompositions and combinations by which the elements in air and in earth become available for the support of plant life; let nature have free course and do her legitimate work, and results will be witnessed on the prairies, in the grain-field, the meadow, the orchard, the vineyard, that will astonish the world and gladden the hearts of the tillers of the soil.

Mr. Parker Earle, of South Pass, thinks that drainage and deep culture

will afford a remedy, in great part, for leaf blights and mildews, for suspended growth in summer, and long-protracted, unhealthy growth in autumn, with hope of relief from the terrible scourge of rot in peaches and grapes, and possibly some amelioration of pear blight. It is a remarkable fact that, while Providence has given the Western States more than an average amount of rain, which, if properly husbanded by deep culture, would add richness to the land and supply every season and stage of plant growth with necessary moisture, the West, in fact, suffers every year the most damaging droughts. The annual rain-fall in southern Illinois is about fifty inches, while New England has about forty, and Old England about twenty-five. About twenty inches of water are annually evaporated in Illinois, which amount would be materially reduced by drainage, thus saving heat in the soil in seasons of excessive rain, which are the cool seasons of the year.

Professor William M. Baker, of the Industrial University of Illinois, in an essay on climatology, asserts that meteorology influences the health, habits, and even the morals of men. The results of destroying the forests in various countries are deplorable, diminishing the annual rain-fall, while freshets become greater, though not lasting. Many streams, formerly with ample power all the year round, now afford it only in the spring and autumn, and many others have degenerated into mere torrents. His illustrations of these facts, though full of interest, are too numerous to be copied or abridged.

The report of Mr. J. P. Reynolds, State agent at the Universal Exposition at Paris, is replete with facts and suggestions. The first and unexpected feature in the landscape of France that strikes an American is the prairie-like openness of prospect, resulting from the absence of farm-houses, with their clusters of secondary buildings, which everywhere dot American scenery. Now and then a pretentious chateau, with some accessories, is to be seen. Proprietors, tenants, and hired laborers reside in adjacent villages, where each family occupies the narrowest limits consistent with its actual need of shelter and rest. Their dwellings may have been built fifty, one hundred, or even five hundred years ago; their gray stone walls, red-tiled roofs, or moss-covered thatch tell no story of their age. Nothing about them suggests an idea of modern or even individual taste. The iron rule of rigorous necessity, exacting durability and economy, would seem to have prescribed their forms, materials, and proportions. A striking feature of the economy universally practiced in France is the utilization of all available wall-surface for the production of fruit; that is, its incidental culture against walls, barriers, and structures erected for other purposes entirely. Mr. Reynolds thinks that this incidental product exceeds the entire fruit crop of Illinois. There is scarcely a farmer who may not profit by the suggestion. An abundance of delicious fruit could thus be raised by every family, without waiting to build a trellis or an arbor. The bare walls of his dwelling, fences, and out-buildings offer surfaces that would produce better fruit, and with more certainty, than the open vineyard or orchard, and are ready for use without the outlay of an additional dollar. A large part of the wood consumed as fuel in France is afforded by faggots, obtained by pruning poplars, willows, elms, and birches, that grow along the margins of brooks, and on the confines of fields. This is obtained without detriment to the crops, or appreciable loss in any respect. More than 160,000 acres are devoted to the production of the osier willow, of which a million of pounds are exported to the United States.

It is singular that no British-made plow received a prize at this in-

ternational trial, although one of them was held by one of the best plowmen of England, and certainly performed its work to the entire satisfaction of its manufacturer. English plows generally do not "scour," and have been condemned as unwieldy, heavy-draught "horse killers," doing little execution in proportion to the strength of team required to draw them. The English, however, seem to have attained perfection in constructing the plow that realizes their ideas of perfect work—to turn a furrow-slice, at whatever depth, so evenly and gradually as scarcely to disturb its component particles of earth in their relations to each other. The line of furrow must be entirely straight, and the furrow-slice unbroken. But other tools and after labors are necessary for pulverizing and preparing the seed-bed for the incorporation of manures and the reception of the grain.

The consumption of cheese in Europe is enormous. Paris consumes annually about 11,000,000 pounds, and all France not less than 200,000,000. American factory cheese is now imported largely into France and England, of a quality equal to the best English. Out of the general habit of eating cheese, however, has grown up a multitude of tastes, prejudices, and notions, so that the richest and best American and English cheese, made from the milk of the finest cows, fed on the choicest grasses, and having a delicious flavor to the unperverted taste, is thrown aside by thousands for a cheese made from goats' milk, with a pungent scent, utterly repelled by the natural nose, and strong enough to give early notice of its presence to a person approaching; or for another kind, made from ewes' milk, into which have been introduced moldy bread and the sporules of a cryptogamic plant, after which the cheese is placed in cool, moist caves, under conditions developing the rapid growth of the fungus and reaching its desirable flavor when a blue-mold has permeated and discolored the whole mass. The latter is extolled by some as the "king of cheeses," and upwards of 6,000,000 pounds are annually made in France, requiring the milk of 200,000 ewes. It sells at the caves for about 12 cents a pound. It is exported to various countries, and in New York its admirers pay 40 cents a pound for it.

IOWA.

Dr. J. M. Shaffer, secretary of the Iowa State Agricultural Society, gives a general view of the agriculture of the State during the past year, abstracts of the reports of seventy-five county and district societies, and several essays, by western writers, on the agricultural development of the State. The volume comprises also the annual report of the Horticultural Society, and is entirely original. The total receipts of the society were $66,209; paid out in premiums, $39,573, or nearly 67 per cent.

The past year, upon the whole, was unfavorable to the farmers of the State, from various causes. The weather and excessive rains were disastrous to the cereals; there was also a large decrease in the number of sheep, and in the production of wool, with losses of swine from disease; a largely increased acreage of wheat, with a crop inferior in quality as well as quantity; a lamentable decline in the cultivation of artificial timber; a falling off in the corn crop, though prices were higher than for many years; enormous crops of grass, but materially injured in harvesting; great inferiority in the quality of apples and a potato crop unparalleled in quantity, with a loss of thousands of acres from an untimely freeze in October.

The rain-fall was enormous, 40.56 inches, against 32.25 in 1868, and

28.6 in 1867, marking it as the "rainy year." Seven inches of rain fell in April and May, that were disastrous in planting and working the corn crop; and the tremendous rains of these months caused a partial failure of the wheat, which, just before harvest, gave promise of the largest yield ever gathered in the State. Besides, the damages to roads, bridges, farms, and fences from floods and high waters may be counted by millions of dollars.

Great losses were sustained in swine by "hog cholera," though many affections, causes, symptoms, and results are probably classed under this general term. Horses are generally better cared for than any other farm stock, and diseases therefore are less frequent among them. A marked improvement is also noticed in horses, of which the assessor's returns show nearly 500,000 in the State. Stallions of the Norman and other improved breeds have been imported into several counties, and a strong infusion of good blood may be expected in the future production of this useful animal. In some counties cattle suffered from disease supposed to be induced by eating smutty corn. Sheep sustained greater losses from diseases than any other farm stock, and a large falling off in the wool-clip is shown. This has caused a general neglect of sheep, and many thousands have been slaughtered for their pelts; in Jackson County alone not less than four thousand. The dogs increase faster than the sheep, and their ravages have been enormous; it is estimated that the sheep killed by them during the year were worth $150,000. An encouraging improvement is noticed in cattle, by the introduction in numerous localities of improved breeds, and fine cattle will induce the cultivation of tame grasses and a lessening of the area of wheat culture. The new varieties of oats distributed by the Department of Agriculture have yielded very largely and met public expectation.

The wheat crop was large in the aggregate, notwithstanding the heavy rains, and about 10,000,000 bushels were exported; an increase of nearly a million of bushels over the previous year. Iowa had also a surplus of 25,000,000 bushels of corn, and over 4,000,000 bushels of other cereals. This gives a large business to the two thousand miles of railroad existing in the State, (six hundred of which were built last year.) Farmers are advised not to give up the culture of sorghum. The product of the crop in 1868 was 2,592,393 gallons, and with proper care in its culture and manipulation, which, it is alleged, it has seldom received, it can be made one of the best paying crops in the State.

The laws passed in 1859 and 1868 to protect wild game from indiscriminate slaughter, and to prevent the reckless killing of insectivorous birds, give great satisfaction. Farmers and fruit-growers believe in the wisdom of these laws, and are determined they shall not be violated with impunity. It is recommended that the legislature also take steps to protect domestic animals from the heartless and thoughtless brutality of many who use them only as a source of immediate profit.

The receipts of the society last year were $66,209, the largest of its existence, exceeding the previous year by $12,738 19; 60 per cent. was paid out in premiums, leaving but little for permanent improvements and current expenses. The number of entries at the last State fair was 2,645, exceeding that of any previous fair by 849.

To show the rapid increase of population and wealth in the State a few counties are mentioned. Black Hawk County has doubled its population in two years, and last year it produced 1,500,000 bushels of wheat, three times the product of 1867. Similar results are given of other counties, although but a mere fraction of the State is yet under the plow.

Mr. P. C. Compton, of Ames, Story County, Iowa, gives the following account of his experience in plowing by steam on the prairies, the natural place for such operations. The machine was invented by Mr. Thomas S. Minnis, of Meadville, Pennsylvania:

The machine (of 15-horse power) consists of a boiler, an engine on each side working on the same shaft, a quarter apart, after the manner of railroad locomotives and the usual connections, all resting on two runners, six feet apart and nearly eight feet long, something like a sled. These runners glide over rollers fixed in endless-chain tracks. The tracks revolve in an ellipse, and the drive-wheels move the chains and propel the machine forward or backward by the same motion. Either side may be run independently of the other. By this means, when drawing a load, it is easily turned or guided. When ready for work, its weight is about eight tons. The width of the endless-chain tracks is one foot, giving a contact with the ground of about 2,300 square inches, and a traction power limited only by the weight.

Attached to the machine were five 14-inch breaking-plows in a solid frame, so gauged as to turn an aggregate of a little over six feet. We ran out on the prairie, a crowd following to see the machine sink in the first slough. They were disappointed. It rode across more lightly or with less impression than did the empty wagons which followed. It drew the five plows through the toughest prairie sod, frequently beam deep, on up and down grade, and through hard and soft ground. The "traction" power of the machine was not fully tested. It frequently drew the plows with only one side in gear, showing this power to be equal to drawing twice as many plows. In this respect it filled what Professor Brainard, in his excellent "History of American Inventions for Cultivation by Steam," pronounces the great want of all machines heretofore tried. It rode over dead furrows, ditches and rough places as smoothly as a sled, touching only the highest points. It also ran over plowed ground with scarcely an appreciable increase of power, was under perfect control, and could be moved either way to an inch. In short, it ran easier, proved stronger, and performed every way, in the main, better than was anticipated, and in the essential necessities of such a machine is a success.

MISSOURI.

The fifth annual report of the State Board of Agriculture of Missouri comprises the transactions of the board; abstracts of the proceedings of the county agricultural societies for 1869; essays on agricultural topics; proceedings of the State Horticultural Society; and the second annual report on the noxious, beneficial, and other insects of Missouri, by Chas. V. Riley, State entomologist. This report is made to the State board, and is full of instructive information, detailed in popular style, and still based on scientific accuracy. The receipts of the board for its last fiscal year were $6,891 60; its expenses $6,509 22, leaving a balance of $382 38.

The St. Louis Agricultural and Mechanical Association is an independent organization, projected by several hundred public-spirited citizens of that city, for the purpose of establishing a popular annual fair. It has a capital stock of $82,000, the interest of which is applied to improving its grounds. During the last thirteen years it has expended several hundred thousand dollars in various improvements and in annual premiums, and last year its premium list was increased to $30,000. It has built a spacious amphitheater, with an arena 250 feet wide, that will seat twelve thousand people comfortably, giving to each person a view of the exhibition in the arena, with two promenades accommodating twenty-four thousand more, so that this immense structure will shelter thirty-six thousand persons; yet at the last fair it proved insufficient, as thousands could not be accommodated, and it is now determined to erect a new building, one-half size larger than the present one. A mechanical hall and one for machinery have also been erected, at an expense of $40,000. Its last fair was a splendid success, there being nearly six thousand entries, and the spacious apartments of the association were overcrowded, and many fine specimens not seen for want of room.

Mr. A. E. Trabue, of Hannibal, Missouri, doubts the expediency of cooking grain for hogs. After a series of experiments on the most economical use of corn and other cereals in fattening and wintering stock hogs,

(having reference to temperature also,) he arrived at conclusions exactly opposite to those held several years ago by Professor Mapes, Cassius M. Clay, the Shakers, and perhaps farmers generally, in favor of the economy of boiling food for stock. Mr. Trabue's experiments, made with the "Chester Whites," led him to the following conclusions:

1. That the breed of hogs has been improved; that we have now one breed, if not more, that can extract every particle of nutriment from raw corn; that can do their own husking, shelling, taking to mill, grinding, packing back, straining and boiling, much better than we can do it for them.

2. That the best temperature in which to fatten hogs is from 42° to 60°, which is usually found from the last of August to the middle of October.

3. That they should have shelter, or access to it.

4. If the fall is dry, they should be turned into the field, to help themselves before the corn hardens, and after it is out of the milk.

5. All there is in corn is 18 to 20 pounds of pork to the bushel, and if fed to an immature pure-bred hog, cooking does not help it.

Mr. Trabue's theory is, that nothing should be fed to animals in a moist state, whether horses, cows or hogs, as they are thereby tempted and enabled to swallow their food unmasticated; while the more they chew it, the better and more intimately it is imbued with saliva, and the more easily digested.

Mr. A. P. Mills, of Warren County, advises greater attention to producing combing and delaine wools, for which the climate of Missouri is as good as that of Kentucky, where they have been successfully grown. While in growing fine wools we have to compete with South America and Australia, where they can be produced profitably at eight cents a pound, we can raise the grades in question at less cost than England or Canada, our greatest competitors; and French and English manufacturers want all the wools of this description that are produced in their respective countries. An immense demand exists for these wools in making lastings and uppers for ladies' and childrens' shoes, the single town of Lynn, Massachusetts, requiring this class of goods to the amount of $1,500,000 per annum; and this is only one branch of trade in which these wools are used. Upwards of 12,000,000 pounds are now annually required in the United States, for which our manufacturers have to depend chiefly on Canada. The fleeces of the Cotswold and Leicester are preferred by the best manufacturers. These are also good breeders and feeders, and as mutton sheep far superior to the fine-wool or the native sheep, and at four years old frequently weigh three hundred to four hundred pounds.

Fruit-raising begins to attract attention. Large vineyards flourish in various parts of the State, and Missouri wines are well known in the Eastern markets for their combinations of rich flavor, delicacy, and strength. Apples are a successful crop, particularly on dry or well-drained soils; in the northern part of the State early winter sometimes catches the apples before they are gathered. If there is snow on the ground, a loss of the fruit is prevented by shaking it into the snow before the sun has power to thaw the apples; they are seldom injured by freezing if gradually thawed. Root-pruning has been successfully practiced for throwing pear trees into bearing, and also for preventing the blight; say, for trees two inches through, prune from twelve to fourteen inches in diameter to a ball of roots; trees three inches, prune eighteen inches from the trunk; and for every inch of diameter of the stem, give a foot of radius in describing the circle around the root-ball to be left. Lime slacked with warm water and thrown into trees will kill the bark-louse and all other soft-skinned insects. Plums are given over to the curculios, which are traveling westward at the rate of sixty

miles annually, and must reach California in a few years, as they will find their way there in fruits and old fruit packages. No preventive of their ravages has yet been found.

At the discussion of the State Horticultural Society it was stated that grapes, much shriveled by long keeping, regain their plumpness by being dipped into hot water and honey, or even hot water alone. The Concord, Delaware, and Wilder, (Rogers' No. 4,) appear to be the leading varieties for the table, and the Ives for red wine. The Concord is productive to a fault, 4,000 pounds to the acre being not an uncommon crop. Such overbearing enfeebles the vines, and thinning out to a reasonable fruitfulness is advisable on all accounts. Mr. A. S. Burrill, of Livingston County, has the largest pear orchard in the State, containing upwards of ten thousand pear trees.

The report of Mr. Charles V. Riley, the State entomologist, comprising one hundred and fifty pages, is full of details in regard to the many insects that have attracted attention the past year, either by their mischief or their benefits. The common apple-worm has been less injurious than formerly, and consequently the orchards were loaded with fair fruit. To destroy this insect it is recommended to place old pieces of rumpled rag or carpet in the crotch of the tree; the worms gather and spin up in them, and can be gathered and killed by wholesale, by scalding the rags, or running them through the wringer of a washing-machine. The apple-root plant louse has become troublesome in some parts of the State. It is a woolly insect, visible on uncovering the roots, which will be found in a knotted, clubbed condition, many of them being merely a mass of excrescences, which so check the circulation of the sap that the tree finally dies. The best remedy is to drench the roots of an infested tree with boiling-hot water, in quantities large enough to penetrate every part of the roots. No danger of injury to the trees need be feared, as it is a general rule that vegetable organizations will stand a much higher temperature than animal, and boiling water has been effectually employed for many years to kill the borer in the collar of peach trees, and the onion maggot, without injuring the growing onions. The plum curculio, still master of the field, has found a new enemy in a minute yellow thrips that attacks it in a vulnerable point, destroying vast numbers of its eggs. It is hoped that in a few years these thrips will reduce the numbers of the curculio, as the lady-birds have done with the Colorado potato bug, and that minute insect, *Acarus mali*, with the common oyster-shell bark-louse of the apple tree. It is suggested that many noxious insects have been introduced from Europe, while the particular parasites that held them in check abroad were not introduced with them. Sometimes, in the case of the imported currant worm, these foreign noxious insects are attacked by native American parasites; but the wheat midge has flourished for half a century without a single parasite troubling it. Dr. Fitch, the distinguished entomologist of New York, as well as Mr. Riley, recommends the importation of the three different *Chalcis* flies from the other side of the Atlantic, as they are known to check it throughout all Europe. Ten years ago the asparagus beetle (*Crioceris asparagi*) was introduced into Long Island, and has spread till its ravages have reached $50,000 in a single county. Taken in season, its mischief might have been checked at the expense of a few hundred dollars. The annual damage by insects to all the crops of the Union is estimated at $300,000,000.

Of all the insect foes of the Western farmer, however, the voracious chinch bug, formerly confounded with the Hessian fly, has become the most formidable; nothing in the way of grain comes amiss to it. In

seasons of great drought it makes a clean sweep. In former years most of these bugs were destroyed by prairie fires, but as cultivation extends less prairie is burned over, and their numbers have annually increased. Mr. Daniel F. Rogers gives the following account of their depredations in 1865:

There was never a better show for wheat and barley than we had here on the 10th of June, and no more paltry crop has been harvested since we have been a town. Many farmers did not get their seed. In a field of barley where the chinch-bugs had been at work for a week I found them moving in solid column across the road to a corn-field opposite, in such numbers that I felt almost afraid to ride my horse among them. The road and fences were alive with them. Some teams were at work mending the road at this spot, and the bugs covered men, horses, and scrapers, till they were forced to quit work for the day. The bugs took ten acres of that corn clean to the ground before its hardening stalks—being too much for their tools—checked them. Another lot of them came from a wheat-field adjoining my farm into a piece of corn, stopping now and then for a bite, but not long. Then they crossed a meadow, thirty rods, into a sixteen-acre lot of sorgo, and swept it like a fire, though the cane was then scarcely in tassel. From wheat to sorgo was at least sixty rods. Their march was governed by no discoverable law, except that they were voraciously hungry and went where there was most to eat. In a neighbor's field, that fortunately was sown *early*, we found them moving across his premises in such numbers that they bid fair to drive out the family. House, crib, stable, well-curb, trees, and fences, were one creeping mass of stinking life. In the house as well as outside, like the lice of Egypt, they were everywhere; but in a single day they were gone.

Their ravages have been sometimes checked by surrounding a field with a barrier of pine boards set up edgewise, and partly buried to keep them in position, keeping the upper edge moistened with coal-tar, daily renewed. Deep holes are dug *outside* of this barrier, and the bugs, arrested in their march, wander about and tumble into the holes, from which they are shoveled out literally by cart-loads. In hot, dry seasons their ravages are always the worst; in wet seasons it is impossible for them to do any considerable amount of damage.

As the chinch bug has to get at the roots in the spring, upon which she lays her eggs, the looser the soil is the greater the facilities offered. Hence the advantages of fall plowing; or if plowed in the spring, the land should have several heavy rollings. Farmers notice that wheat harrowed in upon old corn ground without any plowing is far less infested by these bugs than when put in upon land that has been plowed, and they cannot thrive in wet, soggy land.

The chinch bug has many insect enemies. Four distinct lady-birds prey upon it, (as well as upon the eggs of the Colorado potato bug, and upon those of certain bark lice;) also the lace-wing fly, (*Chrysopha plorabunda*,) the *Insidiosus* flower bug, (*Anthocoris insidiosus*, Say,) and the common quail of the Middle and Western States. This bird should be protected from the gun of the sportsman in every State where the chinch bug is known to run riot. The amount of damage done by this insect is almost incredible. It was estimated that in 1864 "three-fourths of the wheat and one-half of the corn crop were destroyed by it throughout many extensive districts, comprising almost the entire Northwest," amounting to many millions of dollars. As the ravages of this insect have assumed alarming proportions, Mr. Riley has devoted a large part of his report to the subject, which farmers will do well to examine. In summing up the habits of this insect, he considers the following points firmly established:

1. Chinch bugs hybernate in the perfect or winged state, in any old, dry rubbish, under dead leaves, in old straw, in corn-shucks and corn-stalks, among weeds in fence corners, &c. Therefore, all such substances should be burned up, as far as possible, in the spring.

2. The earlier small grain can be sown in the spring, the more likely it is to escape the chinch bug; for it will then get ripe before the spring brood of bugs has had time to become fully developed at the expense of the grain.

3. The harder the ground is where the grain is sown, the less chance for this bug to penetrate to the roots of the grain and lay its eggs therein. Hence the importance of fall plowing, and using the roller upon land that is loose and friable. Hence, also, if old corn ground is sufficiently clean, it is a good plan to harrow in a crop of small grain upon it, without plowing it at all. Moreover, rolling should always be adopted, as the best wheat-growers, both in this country and Europe, attest that the heavier the ground for wheat is rolled, the better the crop.

4. A single heavy rain immediately checks the propagation of the chinch bugs. Continued heavy rains materially diminish their numbers. A long-continued, wet season, like that of 1865, sweeps almost the whole brood of them from the face of the earth; but from the rapid rate at which they multiply, there will always be enough left for seed for another year. It is not only a general, but universal rule, that this insect is never ruinously destructive, except where there is continued hot, dry weather; and if in two adjoining districts there has been a dry summer in one, and much wet weather during the summer in the other, however plentiful and destructive the bug may be in the first district, it will scarcely be heard of in the second.

The natural history of the army worm, canker worm, caterpillar, cabbage worm, bee killer, and prominent insects affecting the grape-vine, as well as innoxious insects, is given with great particularity, making the report of great value to the farmer.

CALIFORNIA.

The last volume of transactions of the California State Agricultural Society comprises the proceedings for 1868 and 1869. The addresses and reports made at the two State fairs are filled with valuable suggestions on the importance of a more diversified agriculture, on artificial forests to ameliorate the climate and beautify the country, on irrigation, and on improved culture of the cereals and fruits, which have become great staples in the wealth of the State. There are also special reports on several subjects, and suggestions on the native grasses of California, beet-root sugar, silk culture, rice, flax, mining, diseases of cattle, immigration, &c.

The receipts of the society in 1869 were $28,497 85, which was all disbursed in premiums and expenses, except $171 78.

The statistical reports for 1868-'69 of leading farm products show aggregates of 19,651,984 bushels of wheat, 7,331,333 bushels of barley, 2,568,757 bushels of oats, 3,226,997 bushels of potatoes, 5,571,152 pounds of butter, 4,422,355 pounds of cheese, and 9,402,364 pounds of wool. Of fruits, there are now under cultivation over 2,000,000 grape-vines, nearly 100,000 orange, lemon, olive, and fig trees, and 2,500,000 apple and pear trees. Of wine and brandy, rapidly-increasing staples, nearly 3,000,000 gallons were produced. Of live stock, 636,468 neat cattle, 2,137,948 sheep, 20,000 Angora goats, and so on, showing wonderful progress in a State but little more than twenty years old, and its chief advance made during the last ten or twelve years. The value of the farming products is estimated at $30,000,000. This entirely eclipses her product of gold, a result which no one would have predicted twenty years ago. The wheat culture of the State becomes vivid to the mind's eye from the single fact that, on the 1st day of August last, 50,000 tons of wheat, in sacks, were stretched along the banks of the Sacramento River, in the counties of Tehama, Butte, Sutter, Colusa, and Yolo, and that 60,000 tons more were to follow them, making 110,000 tons of wheat as the yield of five counties. Five years ago the land from Yolo to Vallejo, fifty-six miles, was unproductive, and almost uninhabited; last year it was nearly one continuous wheat-field. A railroad now runs through this tract, with two wheat-trains daily, one every night, and extra trains on Sundays. For miles along the track last year the wheat was piled up in sacks waiting for shipment, and more than 40,000 tons were shipped from Vallejo direct to Liverpool.

It is regretted by many as a great evil that so large tracts of land are held by individuals who refuse to sell at prices that emigrants are willing to pay. The traveler is everywhere impressed with the immense extent of fields, farms, and flocks. It is stated that in Los Angeles County a person can travel twenty-seven miles of highway through one man's land. Two farmers from Maine, who crossed the mountains in 1852, with 2,000 sheep, now shear 100,000, having a ranch of 200,000 acres. Another firm has 3,500 milch cows; another sold $40,000 worth of wheat from his farm of 13,000 acres. The valley lands are wonderfully rich and productive, with so mild a climate that farm stock is rarely housed. This accounts for the rapid increase of agricultural production.

The consumption of rice amounts to about 50,000,000 pounds annually. As there are thousands of acres of lands on the Lower Sacramento and San Joaquin Rivers eminently suitable in every respect for the cultivation of this valuable grain, and the State has a large population of Chinese and other laborers well calculated for this industry, attention is called to the utilization of these now comparatively worthless lands.

More attention is recommended to planting vineyards. There are many treeless districts in the State, yielding no pasture for grazing purposes, which, by being planted with vines, that flourish even in an arid soil, would soon be covered with verdure; this, in the opinion of meteorologists, would increase the supply of moisture and rain, and materially benefit the grain-grower and grazier. Besides, the vine does not exhaust rich soils as the cereals do. There are vineyards in Los Angeles more than one hundred years old, which still bear full crops every year. More than a million of orange and lemon trees were set out last year in the southern part of the State.

The cultivation of silk, it is thought, will eventually become an important agricultural industry in the State. A moderate premium offered by the legislature has attracted a large number of valuable immigrants, skilled in all the branches of this rich industry, and numerous plantations of mulberry trees have been started. More than 4,000,000 cocoons were raised last year, and a party of Japanese have purchased 2,000 acres of land in El Dorado County, and are busy in raising the mulberry for silk, as well as the tea plant. Some local and apparently temporary causes have cast a shadow over the prospects of the silk business for the past year, but it is thought they will be removed, and a brighter prospect open for its development and successful prosecution. As in most pioneer enterprises, there have been failures, which can now be attributed to plain and palpable causes, and the committee report that, "as a whole, the silk interest is prosperous, and, with perseverance on the part of our silk-growers, they have every reason to look with certainty for a brilliant future."

The question of doing away with fences is now agitating the minds of farmers. They are an enormous expense in California, as in all new States. President Parks says:

> When a man invests $1,000 here for land he is required to invest $2,000 to fence it. Almost every man who desires to farm has the means and ability to acquire a small farm in this country, but there are those who cannot acquire even a small farm and fence it, as required by law. In other words, one man, with six or eight cows, perhaps, will come into a neighborhood and prevent ten men from producing a thousand bushels of wheat each. This is most absurd. There is no reason why one individual should pursue an occupation to the great injury of hundreds of others; no reason why A should be compelled to build two miles of fence that he may raise three hundred bushels of grain, to accommodate B, who milks three cows. Let B take care of his cows. Let him fence ten acres, or, in other words, let him keep his property from trespassing on mine.

This question is just beginning to be agitated, because, perhaps, stock-keepers have heretofore predominated, and it would have cost more to fence the stock than the grain; now the thing is reversed, and it costs ten, yes, twenty, times, the amount to fence the grain that it does the stock. Should we not, then, welcome any measure of relief from this burdensome tax of making and keeping in repair so much superfluous fence?

The importance of irrigation is forcibly presented in the address of the Hon. Geo. Barstow:

Next to railroads, we want canals for irrigation, but constructed with sufficient depth to make them navigable. The seasons of California are two: one of copious moisture, commencing on the 1st of November and closing on the 1st of May; the other is rainless, and extends from the 1st of May to the 1st of November. Could we moisten the earth during these last six months, the productiveness of the State would be absolutely without limit. Many rich mines have been opened in California, and their harvest of gold, by lubricating the machinery of manufacturing and commercial industry, has enriched the world. But no country has profited by it so little as the State which produced it. There yet remains one mine, however, richer than Ophir, exhaustless as the sea, the treasures of which are in store for the people of California whenever they choose to appropriate them. I mean the melting snow of the Sierra Nevada mountains, which the suns of summer send down in fertilizing streams upon the arid plains. We have but to utilize them to find them a source of boundless wealth. * * *

There is no country in which irrigation can be more easily applied now, if we except India, upon so grand a scale as in California. A survey, already made, demonstrates the practicability of watering more than three quarters of a million of acres on the right bank of the Sacramento River, by a canal issuing from that stream, near Red Bluff, leading along the outward edge of the valley, and having its outlet at Suisun; and it is probable that the drainage of the Coast range of mountains would swell the irrigating capacity of that canal to one million of acres. Large as this area is, a still larger one can be irrigated by collecting in a canal the streams heading in the Sierras and flowing into the wide plain on the left bank of the Sacramento and the vast basins of the San Joaquin and Tulare.

CURRENT PUBLICATIONS IN RURAL ART.

We give short abstracts of the new American books on agriculture and rural economy that have been published during the past year. We have aimed at furnishing information only as to their contents and character, by abstracts of their more prominent points, with now and then an illustrative quotation, but offering no criticism, indorsement, or general commendation. It must be an object to the numerous readers of this Report to know what works have been recently published on agriculture, with a general view of their contents. A great improvement is every year visible in the originality of this branch of American literature, and its adaptability to the requirements of the country, so different from the numerous reprints of the English works, which formerly furnished the staple of this kind of reading for American farmers.

PEACH CULTURE. By James Alexander Fulton, Dover, Delaware. Illustrated. 188 pages, 12mo. New York: Orange Judd & Co., 1870.

Within a few years fruit-growing has increased to such an extent as to become a leading interest. Many horticultural associations and periodicals have been established to advance this interest; and these periodicals have been conducted with great ability and with corresponding success. Of these fruits the peach has become one of the most important, being easily raised, coming soon into bearing, and a favorite with almost all tastes. The area of its culture is fast widening, and thousands of acres are now devoted to peach orchards where, but a few years ago, none were known. It can be successfully cultivated almost anywhere under our bright skies, south of 42°, and below an

altitude of 9,000 feet, though not a sure crop north of 40°. In all the States south of Delaware it flourishes with the greatest luxuriance. In this country alone is it grown so abundantly as to become a common marketable commodity, and so cheap that all classes can regale themselves on the delicious fruit at a small expense.

The Delaware peninsula, including the eastern shore of Maryland, has become probably the most productive peach-growing region in the world, the crop sent to market last year having exceeded 3,000,000 baskets, from an area of about six thousand square miles. Some planters in Delaware have peach orchards of 600 acres, with 10,000 to 20,000 trees, and ship 1,000 to 1,500 baskets daily through the season, each basket containing five-eighths of a bushel. Kent County, in Delaware, with an area of six hundred square miles, shipped last year about 1,000,000 baskets. Ohio and Michigan also raise about a million baskets each in favorable seasons; and in California it is estimated that 800,000 trees have been planted in only thirteen counties.

The soil for a peach-orchard should not only be dry, but light and warm. A sandy loam is the best, in which the peach seems to delight, and which accelerates its maturity and fructification. A clay soil is not suitable; a gravelly one, artificially enriched, is better, and the rich alluvials of our river bottoms do very well. Low lands, or those that hold water, are unfit, and must be carefully avoided.

In planting a nursery, the seed of natural, unbudded fruit only should be used, which is a fact not generally known. It is more vigorous, more hardy, and more certain to germinate, and the trees live longer. Although the seeds of budded fruit will generally grow, they are not certain to do so, and they are often diseased and defective, producing diseased and feeble trees. The kernels from natural peaches can be distinguished, as being smaller than those of budded fruit; they are also of fairer, brighter color, closer-grained, harder, and cleaner, with smaller cavities; the two valves are closer and more tenaciously closed. From five to twelve bushels to the acre are required, according as it is planted closely or widely. In the North they are usually planted seven to ten inches apart, while in Delaware only two and a half to three inches; and in the latter case the nurserymen raise from 10,000 to 12,000 first-class trees to the acre. For cultivation in the nursery, transplanting, pruning, budding, &c., in which only ordinary skill and judgment are required, ample directions will be found in Mr. Fulton's treatise.

In selecting a site for an orchard, as the young wood and fruit buds often suffer from the rough northern and northwestern blasts of winter, it is desirable to get a spot where they will be sheltered. A southern or southeastern slope, other things being equal, is to be preferred. Proximity to a large body of water is supposed by some to be favorable, as materially alleviating the severity of winter and preventing the injurious effects of late frosts in the spring. But these beneficial results are sometimes impaired or neutralized by counteracting ones in a fruit so susceptible of atmospheric influences. Thousands of baskets of peaches have been known to rot on the trees in Delaware in a single warm, wet day, from the want of dry air and sunshine. As orchards near water are more exposed to this danger than others, the advantages seem to be nearly equally balanced, and the preference must generally be determined by other considerations. In the large peach plantations in Delaware it is usual to plant early, late, and intermediate sorts, that success or failure may not depend altogether on a single variety, and that the fruit may ripen progressively, affording the planter a supply during the whole season. He is thus better able to manage the crop, it

being easier to send 10,000 baskets of a dozen varieties to market during a season of six weeks than the same quantity of a single variety in a single week. Each kind should be planted in a row by itself, the earliest next the entrance of the orchard, and progressively to the rear, planting the latest last. The planter can thus clear his orchard as he goes; the trees in front being relieved, the limbs will gradually regain their former position, and little or no fruit will be knocked off in gathering. The trees may be transplanted in the fall or spring with equal success. In the fall first-class trees are more readily obtained, as the nurseries have not then been culled nor the stock exhausted, as is often the case in the spring. The ground is generally in better order then, and it is a time of more leisure with the farmer. In fall planting it is best to leave a few branches toward the top of the stem, as a sort of shield from the frosts of winter. If planted in the spring, the trees should be trimmed close and smooth like a rod, every limb taken off, and the top cut down to a uniform height of about three feet. Those planted in the fall should be treated in the same way in the following spring, as early as the weather will permit. In June, after planting, every limb and sucker should be cut off that is nearer than two and a half feet to the ground, as well as any straggling limbs that may have grown far beyond the general contour of the head. If this trimming is done judiciously and timely, the limbs that are left will grow strong and vigorous, the wood will ripen early, and the vitality of the tree be preserved. A height of three feet is a proper distance at which the head should be allowed to commence its form. At this height it will naturally strike upward at an acute angle with the stem, and thus allow room enough to cultivate around it with a mule or small horse. Many planters "cut in" young trees annually, about one-half of each year's growth, the same season or early next spring. When the sap reaches this point it is, of course, checked, and sends out new branches; thus more new bearing wood is produced, nearer the stem and nearer the ground. This does well in small orchards, but is hardly practicable in plantations of thousands of trees. Cutting in also invigorates and prolongs the life of the tree; the leaves will be greener, the young bearing wood more abundant, and the fruit larger and richer.

A full crop of peaches, say a basket to a tree, may be expected the fourth year after planting. This is a full crop for trees of that age and size, and quite as much as they ought to bear. It is not easy to account for the difference in production; something depends on variety, culture, &c. Some kinds, as Hale's Early, uniformly bear large crops, while others, as the Susquehanna, a fruit of great beauty and excellence, are uniformly light bearers. It is not generally desirable that trees should bear when very young; it weakens the tree, in diverting the vital forces from the formation of wood into the production of fruit, oftentimes giving the tree a lasting tendency to feebleness; besides, at an early age neither the stem nor the branches are able to bear a load of fruit; they break down, and the tree is thus permanently injured, both in usefulness and beauty.

The culture after a crop should be prompt, careful, and generous. As soon as the last peach is gathered the hogs should be turned in to eat up the refuse. They will fatten on the decayed and imperfect fruit, and multitudes of embryo insects will be destroyed. They will root about the trees, which will do almost as much good as a plowing. If there are no hogs at hand, the refuse should be gathered up and removed; but this is too seldom done, the more common way being to leave all on the ground, and run the risk.

The next thing is to remove carefully all feeble, dead, and broken limbs. These are such as are near the ground, and have been so far deprived of their sap by the upper and more vigorous ones as to become unfruitful. As they would soon die, it is best to remove them at once, and thus give more room as well as more sap to the thrifty and fruit-bearing ones. After a bountiful crop many broken limbs will be found; sometimes the whole tree will be demolished and apparently ruined. By careful and judicious pruning much may be done to repair the injury and restore the tree to its former beauty and usefulness.

After this the root of every tree should be carefully examined for the borers and every one be destroyed, the ground carefully plowed and cultivated down, and all completed by the 1st of October. The ripening of late fruit may retard the plowing, but the worming must not be deferred if you value fine trees, and wish to preserve them. In a well-attended orchard the labor will be light; for, where the planter is vigilant, few worms will ever obtain a lodgment in his trees. After the examination of each tree the soil should be carefully replaced, so that the tender *neck* of the stem will not be exposed.

After the fall plowing it is advised to give the orchard a top-dressing of lime, or barn-yard manure, ashes, or superphosphate about the roots. Although this is somewhat expensive, any good orchard that is worth keeping at all is worth good culture, and whatever dressing it gets should be in the fall, that the fertilizers may dissolve, soak in, and reach the roots during the winter, in time to stimulate and strengthen the next year's growth and crop. Neither weeds nor grass should be permitted to grow, and the ground should be kept as clear and smooth as a floor.

But little is yet settled in regard to the diseases of the peach. The "yellows" is regarded as incurable, and *eradication* is the only remedy recommended. This disease is ascribed to bad cultivation, or rather to long cultivation on the same soil. At an early day in this country the yellows was unknown, and in newly-cleared districts and fresh soil it is never seen except where it has been introduced by diseased trees. The borer is the most troublesome enemy of the peach, but if looked after in time it is easily subdued, and need not seriously interfere with cultivation. The eggs from which this pest is produced are deposited by a four-winged, wasp-shaped insect, during the summer, on the tender bark of the tree, at the surface of the ground. As the season advances the eggs hatch into small white grubs or *borers*, about an inch long and an eighth of an inch in diameter, which penetrate the bark and bore into the sap-wood, where they remain all winter. The next spring they emerge in their perfect winged form, and soon commence depositing eggs for another generation. While in the tree they devour voraciously the bark and sap-wood, and one or two are sufficient to destroy a young tree in a single season, and four or five will destroy an old one. A little experience will enable one to detect the borer. The most certain and obvious sign is the gum at the neck of the tree; that is, the tender part which extends about an inch above and two below the surface. When this is discovered, the earth should be scraped from the root, the gum and decayed wood cut away, and a stiff wire or whalebone thrust into the curving cavity, and the worm be thus destroyed. Care must be taken to kill all, as sometimes five or six will be found in the same tree. The dead and diseased wood should be carefully removed, so that the new growth may cover the old wood as soon as possible. After the operation the soil should be drawn up to the neck of the tree again, to prevent the evil effects of the sun or dry winds in summer, or the severe frosts in winter. The application of boiling water, the waste water from salt-works, and oil diffused in water have all been proposed as remedies, but are all inferior to the punching operation with a wire or whalebone. Sheathing the tree with strips of thick paper, straw, or cloth, a foot wide, is a good preventive, if kept on from the middle of June till the middle of October. The paper should extend two inches

below the surface, the dirt being scraped away for the purpose. After adjusting the paper properly, the dirt should be drawn back and pressed down firmly.

The curculio, or plum weevil, has become very troublesome at the West in peach orchards. This dreaded insect has nearly banished plums from our gardens. Many remedies have been recommended. The most efficacious is jarring the tree with a sudden blow by a mallet; this dislodges the insects, which fall upon sheets placed under the tree, and are gathered up and destroyed. Bandaging the trees with strips or bands of wool, cotton, or rope, dipped in coal or gas tar, is recommended, the offensive odor of which is always effectual in driving away insects. Covering the ground with a heavy coat of whitewash of lime, or of lime and sulphur, and planting in paved yards, or where the branches will hang over water, on the principle that instinct teaches the curculio never to deposit its eggs where they cannot be hatched, are also recommended. They are, at least, palliatives. A cheap, convenient, and certain preventive or remedy for the ravages of this insect is a desideratum earnestly desired, but it is a blessing which has not yet been conferred.

In the selection of sorts, it is impressed upon beginners not to plant too many varieties. In no case should they exceed twenty; in most, twelve will be enough, and in some six, say Hale's Early, Oldmixon Free, Stump the World, Crawford's Early, Reeves's Favorite, and Crawford's Late, (the first three white, and the last three yellow,) will be better than twelve, depending on various circumstances. The white peaches are distinguished for the tender, delicate, and sparkling quality of their flesh; the yellow, for their bright color, rich juice, and great size. To the multitude the bright color and large size of the yellow peach are irresistible, and generally they sell better in market than the white.

Mr. Fulton concludes his book with directions for the construction and management of peach houses, and a descriptive catalogue of the most valuable, as well as of the fancy varieties, many of which descriptions are the results of the author's extensive experience.

THE APPLE CULTURIST: A complete treatise for the practical pomologist, to aid in propagating the apple, and cultivating and managing orchards. Illustrated with engravings of fruit, young and old trees, and mechanical devices employed in connection with orchards and the management of apples. By Sereno Edwards Todd, author of the "American Wheat Culturist," &c. 12mo, 334 pages. New York: Harper & Brothers, 1871.

In this work Mr. Todd gives the result of his experience in the propagation of apple trees and the management of orchards. Propagating the trees, grafting and budding, preparation of the soil and laying out the ground for orchards, removing, transplanting, pruning, and training both old and young trees, and renovating old and declining orchards, are discussed.

Farmers often complain that on light and sandy soils their apple trees are failing, and that after one or two fair crops they bear but few or none. In such cases their trees require a supply of clay in the soil. This is particularly so of the light soils of New Jersey and Long Island, where these complaints are general. There is nothing available in the soil from which the roots of the trees can produce apples. In such cases a ton or two of clay, a few bushels of lime, a top-dressing of rich compost, would cause the trees to hang down with plump and luscious fruit. Fine-looking trees may be grown, but without the proper ingredients in the soil they will bear only inferior crops of small, knotty, scabby, and

one-sided fruit. A mellow, fertile soil is necessary, which should be deep enough to allow the roots to extend, and be dry and well drained, to prevent injury from stagnant water below the surface; firm, and not peaty or spongy, to preclude disaster from frost, mildew, or rust. The only trees that will not bear a high fertility are those brought originally from warmer countries, and liable to suffer from frosts, as the peach, nectarine, and apricot, which would be stimulated to a late growth, and the immature wood be injured in winter. Granite soils are among the best for apples, as this rock abounds in feldspar and mica, both of which contain potash. As these rocks disintegrate and enter into the composition of the soil, they supply one of the most necessary elements for the formation of good trees and apples.

In regard to the proper time for pruning there is great diversity of opinion among pomologists, their recommendations ranging from midwinter to midsummer. Some, implying that to do the work well is more important than to do it at any particular season, say it should be done "whenever one's knife is sharp." After mentioning the diverse and sometimes obscure views of writers on this question, Mr. Todd says it is best to begin to lead and direct *in the bud*, and in early spring to pinch off certain buds that would grow into branches which must ultimately be cut off. In a word, the true secret of scientific pruning and training is to pinch off a bud that would make a branch that must be cut off. An experienced pruner, by a glance at a young tree, can see the proper buds to be removed, and in three minutes prune it with his thumb-nail, so that the tree *may* need no more care for the season. Trees thus managed will never need the cutting away of large limbs, except when injured by teams, or broken by snow or wind. While there is no uncertainty as to the expediency of top-pruning, Mr. Todd is skeptical as to any advantage in root-pruning; and this, after investigating the subject thoroughly, and having been on the watch for many years for a single instance or experiment affording an argument in favor of the practice. Where there is danger of the growth of wood being extended so late in the autumn that the new growth would be killed in winter, the true remedy is to pinch off the terminal buds, instead of severing the roots. This will check the lateral and upward growth of the branches, and the sap and cambium will at once begin to develop the buds, thus inducing fruitfulness and promoting the maturity of the green wood and tender branches, so that before cold weather every twig and shoot will be fully ripened and prepared to withstand the rigors of winter. By pinching or clipping the terminal twigs late in summer on some trees, and late in September on others, the pruner will have complete control of the growth and development of the branches. If the twigs commence growing a second time, they should be clipped again. By such management for one or two seasons this rampant growth can be so controlled that the great flow of sap will promote abundant fruitfulness, rather than surplus wood.

The practice of scraping old trees so thoroughly as to remove all the shaggy, dead bark is pronounced worse than useless labor, except where it is evident that the bark conceals insects or their eggs. In that case the denuded parts should be protected with a coat of pitch and tallow. This rough bark is provided by nature as a protection against the adverse influences of climate, and for maintaining in even balance that degree of warmth favorable to the healthy exercise of the functions of growth and productiveness. Wood, particularly in the direction across the grain, is a non-conductor of heat in an eminent degree. This practice of scraping off the rough bark promotes no good end. Even the

long strips of dead bark hanging from the trunks and limbs of large hickory trees are of more service than injury, and it is doubted if even moss or lichens are hurtful to trees, as they live exclusively upon food drawn from the atmosphere, and in bleak and exposed situations they may supplement the bark in affording protection. When covered with moss to excess, it may be presumed the trees are in an unsatisfactory condition, either from impoverishment of the soil, want of drainage, or exposure to the rigors of a severe and variable climate. Slitting the bark up and down with a knife, with the idea that the tree is bark-bound, is absurd. Digging about the roots and washing the trunk of the trees with ley, soap-suds, or chamber slops is all that is wanted. Thinning out the fruit, particularly on young trees, is urged; the growth of the tree is thus promoted, and the crop will be more abundant as well as more valuable. It is recommended that orchards be well manured before the trees are set out, and the surface top-dressed every two years. Moderate applications of lime and generous ones of wood-ashes are always profitable, and phosphates are useful if buried beneath the surface; also Peruvian guano, if slightly covered, late in the fall, so as to become thoroughly divided by winter rains. Coarse organic manure should not be used in contact with the roots of young trees, but chip-dust, fish, flesh, and the bones of dead animals, horn-piths and hoofs, hair and old plaster, and all like articles, are good for growing trees. Pear trees that have not borne fruit for twenty years have been brought into full bearing by yarding two shoats beneath the tree in August and September, in an inclosure a rod square, having their beds close to the body of the tree. In this yard holes were made with a crowbar, into which kernels of corn were dropped, and the whole yard was rooted over and over to the depth of eight to twelve inches, and many of the roots were torn up. The next season every branch was filled with plump, luscious fruit, and for many years the trees continued to yield bountiful crops.

Belts of timber-trees to protect orchards on the western prairies from the cold winds of winter are urged as indispensable to successful culture in such locations. Reliable authorities at the West estimate the loss in fruit trees in Illinois, for the last three years, at millions of dollars, chiefly from want of protection, on land underlaid with the retentive clayey loam sub-soil of most of the prairies. Ridging such land by repeated plowings is recommended; nursery trees placed on the apex of such ridges are not thrown out by freezing, and make a better growth in summer. Thorough draining, also, would doubtless lessen the effects of severe winters on fruit trees in other regions as well as at the West. The scathing influence of these dry cold winds is felt not only on fruit trees but in many localities where bountiful crops of golden grain were formerly harvested, the tender wheat plants, unprotected by surrounding forests returning a greatly diminished product.

The volume closes with a chapter on the general principles of pomology, and a glossary of words used in pomological science. The book is well printed and illustrated, and contains what is too often neglected, an ample index.

The Strawberry and its Culture: with a descriptive catalogue of all known varieties. By J. M. Merrick, jr.; 12 mo., pp. 128. Boston Tilton & Co., 1870.

The steadily increasing interest felt in the cultivation of strawberries has induced Mr. Merrick to prepare a manual on the subject, comprising practical directions on the proper manures and preparation of the soil; methods of cultivation; insect enemies; on forcing strawberries; the production of new varieties; the question of taste, &c. The fact that,

forty to fifty years ago, two or three now forgotten kinds supplied the market, and a man who picked fifty boxes a day was considered a large strawberry-grower, while now hundreds of varieties are cultivated, and single commission houses frequently sell ten to twelve thousand boxes a day, shows the immensely increased estimation of this delicious fruit.

While the wild native strawberry ripens its small berries on the forest soil, and many kinds do well though poorly fed, there is scarcely one that will not do better on well-manured land; and it may be said generally, as in the case of other crops, that the more manure the more strawberries. Almost any fertilizer can be used to advantage, either in preparing the soil for a plantation of this fruit or for a top-dressing, as stable manure, compost, unleached ashes, superphosphate of lime, guano, fish manure, and hen-droppings. Some consider lime injurious, when used alone, but superphosphate of lime is certainly beneficial. Guano alone scattered broadcast half a dozen times through the summer, before a rain if possible, at the rate of one thousand pounds to the acre, produces wonderful results, and may take the place of all other manures. Where it is desired to produce new runners in propagating new varieties unleached ashes are a good fertilizer, but should, of course, never be used with guano. Market-gardeners who plow in stable manure liberally, even spading it in between the rows, are rewarded with large crops of superior berries. The finer the manure the better. A fall top-dressing of horse manure is excellent, acting both as a fertilizer and protection, but it should be light and strawy. A top-dressing of heavy green manure applied in the fall is ruinous to this plant.

The soil for strawberries can hardly be too fine or too deep, as the roots extend farther than is generally imagined. Corn, potatoes, and any vegetable that requires clean culture, are good crops to precede this fruit. An old strawberry bed that is done bearing can be plowed under and followed by potatoes, with excellent results.

Pasture or grass land selected for strawberries must be cultivated for at least one year, with some clean-hoed crops, as such lands are apt to be filled with the larvæ of the May-beetle, or dor-bug, (*Phyllophaga quercina.*) The ravages of these larvæ or grubs are sometimes disheartening. They abound in old grass land and pastures, and live chiefly upon grass roots. When only a few show signs of their presence in well-established beds of strawberries they should be at once dug out and killed. They can be found in the morning close under the plant they have killed. Skunks are very fond of them, and dig them out and eat them with avidity. The well known rose-bug sometimes destroys the foliage of the plants, for which there seems to be no remedy but hand-picking and burning or scalding. Ants occasionally swarm upon the berries, but may be disposed of by pouring boiling water into their hills. A sudden cold rain sometimes causes the blossoms to blight, and overripe fruit will mold on the vines in damp weather; but, after all, strawberries are subject to as few fatal contingencies as any plant.

With proper appliances the strawberry can be forced with less trouble than almost any other fruit. The vines should be of the previous season's growth, with full crowns, plump, well ripened, and mature. The Triomphe de Gand and La Constant are excellent varieties for forcing, and often produce splendid crops in March. The first runners from good plants should be layered in thumb-pots in July, which in a few weeks will be filled with roots. The young plants will then be ready for shifting into three or four inch pots; they should then be well watered and set in a cold frame, and when well filled with roots, again shifted into larger pots. When cold weather checks their growth in November, they should

be placed in a frame, and covered with leaves and boards till January, then gradually started and sparingly watered with guano water, made by dissolving four or five pounds of guano in a barrel of water. Keep the runners cut off, the temperature at 75° by day and 60° by night, and a crop of fruit may be expected in ten or twelve weeks after the vines are brought into the green-house.

Mr. Merrick concludes his book with a descriptive catalogue of several hundred varieties, filling sixty-eight pages, compiled from various American and European authorities, which shows a great amount of labor, and is more complete than any other extant.

CRANBERRY CULTURE. By Joseph J. White, a practical grower. Illustrated. 12 mo. pp. 126. New York: Orange Judd & Co., 1869.

The culture of cranberries is still in its infancy. Within a few years they have attracted deserved attention, and the demand has increased much faster than the supply. Thirty to forty years ago but few were gathered, which were sold at 75 cents to $1 per bushel; but the steadily increasing demand has caused the prices to advance, and notwithstanding the greatly extended production, they have risen and ranged from $4 to $6 per bushel, and in 1868–'69 many growers realized $10 per bushel. Some of the best cranberry bogs in New Jersey are worth $2,000 per acre.

The cranberry grows naturally in moist bottoms. It requires a peat or muck subsoil, free from loam or clay, which, where the peat is six or eight feet deep, should be covered with beach sand to the depth of five or six inches; where the peat is only a foot or two deep, two or three inches of sand are sufficient. The latter should be clean, rather coarse, and entirely free from any mixture of loam. A good test for the proper sand or gravel to be used in cranberry culture is this: Take a portion of the soil, and compress it tightly in the hand; if it is suitable, it will fall apart upon being released; but if composed in part of loam, it will adhere together after the pressure is removed. The cranberry will grow in pure muck, but in such case the growth is apt to be so vigorous as to render the vines unproductive. The sand checks the too luxuriant growth of the vine, and prevents the growth of weeds. Flooding in winter is desirable, for the purpose of killing the vine-worm and other insect pests.

In planting cranberry vines several modes have been followed: 1st. Sod planting, by taking from their native marshes sods containing cranberry vines, moss, turf, &c., and placing them on prepared or unprepared meadow, was formerly practiced, but is now discarded. 2d. Hill planting, with bunches of clean vines, in drills two feet apart each way, and a handful of vines planted at each intersection; but large bunches have a tendency to dry up and become woody, thus injuring the plantation. 3d. In drills requiring no sanding, but susceptible of being prepared with the plow, the best method is to "strike out" the ground with a plow, in rows three feet apart, and scatter the vines thinly and evenly along the furrows, putting only one or two in a place. They should be inclined against the "land side," projecting four or five inches above the surface, after which the hoe is required to fill up the furrow and thoroughly cover the roots; this causes them to sucker and grow more luxuriantly than when left standing upright, to be swayed by the winds. 4th. On soils properly prepared by spreading sand over muck or peat, the best mode is to mark out the ground fourteen inches apart with a small sled having three runners; the vines are then dropped in these marks, say two in a place, fourteen inches apart in the rows, and pressed

into the ground with a spade-like tool placed on the vine, about one-fourth the distance from the root to the top. The roots of the vine should be pressed into close proximity to the muck below, that they may be stimulated to grow more rapidly. 5th. Spreading the vines evenly over the surface of the meadow, and then covering them about an inch deep with sand, has succeeded well in New Jersey. The young shoots come up through the sand as thick as wheat, making an excellent growth, and the whole surface is soon matted with them. This mode requires more vine than the others, but yields a crop sooner than by planting in any other way. 6th. Sowing by cuttings can be done successfully, the vines being passed through a straw-cutter, and chopped into pieces about an inch long; they are then sown like oats upon an evenly-prepared surface, and harrowed in. This must be done early in the spring, and upon moist ground, so that the cuttings will become well rooted before the heat of summer. 7th. Attempts have been made to grow them from the seed; but, owing to the longer time required for the vines to become productive, and the increased expense of keeping them clean, this system has been abandoned for general culture.

Great care should be taken in selecting the vines to procure those which yield large berries. The shape of the fruit is of little consequence, the great *desideratum* being to obtain berries of good size and color. Until the vines are well matted, it is important to keep the meadow thoroughly drained at least one foot below the surface. It will generally be found necessary to go deeper than that to effect a thorough drainage, without which the vines will not thrive, even if planted on ground well adapted to their growth. If the meadow is allowed to remain very wet, the vines will make little or no growth. When properly drained, a good meadow will become matted in three years, although some of the most permanent plantations have required a longer time to come into full bearing, owing to the dampness of the soil.

There are several insect enemies, however, that the cranberry grower has to combat. For the extirpation of most of them water is probably the most efficient agent. In the climate about Cape Cod it is recommended to flow the bogs once or twice between the 10th of May and the 10th of June, say for a day or two, that is, if the water has been drawn off early in the spring. If the water has been kept on till the 1st of June, it is well to flow two or three times during the month. The common blue-bird is a great destroyer of small caterpillars and worms, and it is hoped that the European house-sparrow, now becoming so generally domesticated, may prove an efficient auxiliary in destroying the several kinds of worms that prey on this fruit.

Mr. White concludes his book, the results of several years' experience, with directions for picking, keeping, and preparing the fruit for market. The home demand is so great that very few are left for exportation. Should there ever be a surplus, an active demand for them always exists in Europe and the West Indies. The requisites for establishing a cranberry plantation, as gathered from Mr. White's book, may be summed up as follows: 1. A sub soil or bottom of peat, or peaty matter. 2. No cold spring, but a head of water, so that the bog may be quickly flowed at all times, to protect it from the ravages of insects. 3. The turf or top soil of roots, grass, &c., must be removed down to the peat. This top soil will make a good material for compost on high land. 4. Ditches must be made so that the water can be drained to at least a foot below the surface during the growing season; especially the cold water from the borders must be drawn off. 5. The surface of the peat, after the soil is removed, must be covered three to twelve inches deep, according

to the depth of the sub-soil, with sand that contains no loam, nor grass or weed seeds—such sand as will not adhere when pressed in the hand. 6. Vines should be set in hills or rows, fourteen to twenty-four inches apart; spring is the best time for doing it, or say from the middle of April to the middle of June. It is important that they should be planted at an inclination *in all cases;* thus bringing the tops near the ground, and causing them to sucker better than when pressed down perpendicularly.

PRIZE ESSAY ON THE CULTIVATION OF THE POTATO. By D. A. Compton; 8vo, pp. 30. New York: Orange Judd & Co., 1870.

Two years ago the Rev. Mr. Wylie, of Bellefonte, Pennsylvania, offered a premium of $100 for the best essay on the cultivation of the potato, the premium to be awarded by Mr. Weld of the American Agriculturist, Mr. Fuller of Hearth and Home, and Dr. Hexamer, who has made the cultivation of the potato a special study. The premium was awarded to D. A. Compton, of Hawley, Wayne County, Pennsylvania, who, within a reasonable compass, describes with sufficient minuteness of detail the mode of culture which his experience and observation have proved to be best adapted to this crop. The writer has been engaged in farming from early youth, and his statements are based on actual personal experience, being the results of many experiments made to test as many theories. He discusses the proper soil, manures, varieties, the potato rot, and the various insects that prey upon the potato plant in this country.

The potato is most profitably grown in a warm, dry, sandy, or gravelly loam, well filled with decayed vegetable matter. New lands, or lands recently denuded of the forest, if not too damp, produce tubers of the best quality. When grown in dry new land, the potato always cooks dry and mealy, and possesses an agreeable flavor and aroma, not to be attained in older soils. In no clayey soil can it be raised to perfection as regards quality, though large crops of coarse-fleshed tubers may be obtained in favorable seasons. The soil must be enriched by plowing under green crops, such as clover, buckwheat, peas, &c., or by swamp muck that has been drawn to the field in winter, exposed in small heaps to the frost, and mixed in the spring with a little lime to neutralize the acid. Sea-weed, when bountifully applied, has no superior as a manure for the potato. No stable or green barn-yard manure should be used on this crop. Stable manure predisposes the tuber to rot, and detracts from the desired flavor; and not half so large a crop can be obtained with it as with different manures. It is a good plan to sprinkle a handful of phosphates, wood ashes, or lime in the hills at planting, and an equal quantity of wood ashes, or lime slacked in strong salt brine, just before the last hoeing.

No better method can be adopted to bring up partially-exhausted lands than plowing under green crops. A farmer can thus take up lot after lot, and soon bring all into a high state of fertility. It costs no more to cultivate an acre of rich, productive land than an acre that is poor and unproductive; and the pleasure of harvesting a heavy crop abundantly rewards the farmer for his extra labor in preparing his soil. Besides, the beneficial effects of manuring with green crops are not transitory; the land shows this generous treatment for many years, and if lime or ashes be now and then added to assist decomposition, it will continue to yield remunerative crops long after land that has been but once treated with stable manure or guano fails to produce any thing but weeds. Manure of some kind must be used, and to most farmers no

mode of enriching land is so feasible, so cheap, and attended with so satisfactory results, as that of plowing under green crops. If the soil is so poor that clover alone will not take root, seed it down with millet and clover very early in the spring, harrowing in with the millet thirty bushels of wood ashes, or two hundred pounds of guano; then sow the clover seed, say one peck to the acre, and harrow it in.

Astonishing results are obtained from plaster, by dusting the vines with it as soon as they are fairly through the soil; again immediately after the last plowing and hoeing; and at intervals through the whole growing season. The first application may be light, the second heavier, and after that more bountiful, say two hundred pounds to the acre. The action of plaster is not easily explained, but the results are undoubtedly beneficial, particularly in seasons of extreme drought. It renders plants less palatable to insects, and appears to be fatal to many of the fungi family. The vines retain a bright, lively green color, and the tubers continue swelling until growth is stopped by the frost; besides, potatoes thus grown are so sound and free from disease as to be easily kept for spring market, without loss by rot. Mr. Compton has seen a field, all of the same soil, all prepared alike, and all planted with the same variety, at the same time, on one-half of which, that had received no plaster, the yield was but sixty bushels per acre, and many rotten; while the other half, to which plaster had been applied in the manner above described, yielded three hundred and sixty bushels per acre, and not an unsound one among them.

Potatoes should not be planted year after year on the same spot; trouble with weeds, and rapid deterioration of quality and quantity of tubers, soon render the crop unprofitable; and loamy soil thus planted continuously soon becomes compact, heavy, and lifeless. Most growers argue that potatoes should be planted whole, as a greater supply of starch is thus available, until the plant can draw support from the soil and atmosphere. Mr. Compton thinks, however, that the poor results attending cut tubers are traceable to improper ones improperly cut. Large, mature, sound tubers only should be used, cut in pieces of two or three eyes each, with as much flesh as possible around and under each eye to the center of the tuber. The seed should be often changed. The best and most extensive growers procure new seed every two or three years; some every year.

When the tops are two inches high, run a corn plow five inches deep, *close* to the hills, turning the furrows *from* the hills; plow both ways. Standing on the squares of earth, warmed on all sides by the air and sun-light, the potatoes grow rapidly. As soon as the tops are six or seven inches high, plow seven inches deep, midway between the rows, turning the furrows *to* the hills. Hoeing is generally unnecessary; but when needed, draw mellow earth to the plants with the hoe, keeping the top of the hills somewhat hollow to catch the rain. Then, as far as stirring the soil is concerned, *let it alone*, as after a certain stage new tubers are formed each time the soil is disturbed; and if the last plowing be deferred until the vines are large, a great quantity of small potatoes is sure to be the consequence.

Mr. Compton closes his essay with remarks on the value of the potato as food for cattle; and an elaborate chapter, with illustrations, on the ten distinct species of insects that prey upon the potato plant.

ONION-RAISING: What kinds to raise, and the way to raise them. By J. J. H. Gregory, seed-grower, Marblehead, Massachusetts; 12 mo., pp. 35. Salem, Massachusetts: Geo. W. Pease & Co., 1869.

This is a small work, but of a decidedly practical character, in which the author gives his long experience in onion culture, in a neighborhood

where one hundred thousand bushels are raised annually; as well as the results of personal observation in other localities; and facts gathered by correspondence with different sections of the Union.

Onions thrive best on old ground. They have been grown in some parts of New England on the same spot for nearly a century, without any perceptible falling off in the quality or quantity of the crop, though some think that in such cases there is a greater liability to rust. They give the most satisfactory results on soils of light structure, such as a sandy loam, or even on a gravelly soil, if it is not of a leachy nature, and if it rests on a hard-pan bottom. It should be heavily manured with either Peruvian or fish guano, or pig and barn manure, night-soil, kelp, muscle-mud, superphosphate of lime, wood-ashes, or muck, all of which, used either alone or in compost, are excellent food for the onion. Wood ashes are generally used in connection with other manures, at the rate of about two hundred bushels to the acre. They must never be *combined* with other manures, as they would set the ammonia free, and thus deteriorate their quality. They should be scattered on the surface at the time of planting, or when the crop is about half grown.

The soil for onions does not require deep plowing; four or five inches are sufficient to insure a good crop. The great object is to get the land in a thoroughly fine condition, to facilitate the covering of the seed with fine earth; to have the soil light, that there may be a vigorous growth of the plants, and to leave the land in good working condition for after culture. As onions, when grown from the seed, generally require the whole season to ripen, the ground should be prepared and the seed planted as early as possible in the spring. As a general rule three and a half pounds of seed are sufficient for an acre, or, if the land is very highly manured, four pounds may be planted with profit. This is where large onions are wanted for fall or winter use. But if it is designed to pull them when small for the early market, then seven or eight pounds will be required to the acre. There are many different machines used for sowing the seed. The Large Red, Yellow, and White are the three standard varieties in this country. The Danvers, a comparatively new sort, is very prolific and early. This and the Large Red are extensively raised for market as well as for shipping. The Potato and Top onions are rather fancy sorts. The former is very mild and pleasant to the taste, but rather a poor keeper. It has the advantage of being quite early, and not very liable to injury from the onion maggot when that pest abounds; it is best developed on soil rather moister than the varieties from seed require. The Top onion, though of mild and pleasant flavor, is coarsely and loosely made up, is a poor keeper, and has no particular merit over the common sorts.

South of New Jersey onions cannot be relied on to mature the first year from seed, as the extreme heat of the climate forces the formation of the bulb, and dries down the top quite early in the season. In the Southern States, therefore, two years are necessary to mature the crop. The seed is sown very thick, say thirty pounds to the acre; the crop matures in July, when it is pulled, stored in cool, airy lofts, and spread thinly over the floor. The next spring the bulbs are planted in rows, say ten inches apart, and two or three inches distant in the row.

The onion crop is sometimes severely injured by rust or mildew. The tops of the leaves die, and the whole plant is more or less covered with patches of thin white dust, which stops the further growth of the bulb. This disease is most frequent in very wet seasons, and is more common on old onion beds than on new. The best remedy known for old beds is to run the plow a little deeper, and thus bring up and mix in a little

new soil. Mr. Gregory closes his treatise with a description of the various drills and labor-saving machines used at the North in the culture of this crop.

CABBAGES: How to grow them. A practical treatise on cabbage culture, giving full details on every point, including keeping and marketing the crops. By James J. H. Gregory, introducer of the Marblehead cabbage; 12 mo., pp. 72. Salem, Massachusetts, 1870.

This little treatise gives plain and practical directions for the cultivation of the cabbage, with its congeners, the cauliflower, broccoli, &c., describing the proper soil, the diseases of the plant, and its insect enemies, with a description of the most desirable kinds for either the table or live stock. Although it is a familiar plant in almost all gardens, there are many hints in Mr. Gregory's book that will be new and useful to beginners, particularly in selecting the best varieties.

The Winnigstadt variety, that makes a hard head under almost any condition, is recommended where the soil is light. Deep fall plowing is urged, that the frost of winter may disintegrate the soil. Almost any manure, except hog manure, will answer for cabbages, as barn manure, rotten kelp, well-diluted liquid manure, night soil, guano, phosphates, wood ashes, fish, salt, glue-waste, hen-manure, all properly composted, or slaughter-house offal, and the richer they are in ammonia the better. Hog manure is thought to invariably produce the club-foot disease in cabbage, though Mr. Henderson, of New York, ascribes it to an insect that deposits its eggs in the soil; and in the maggot condition in which it appears the second year it attacks the roots, which become large and carious, ruining the plant. On this theory cabbages, cauliflowers, rutabagas, and turnips can be safely grown on the same spot only in alternate years. On soils containing a large amount of lime, this insect cannot exist to an injurious extent.

In New England the largest cultivators for market drop the seed directly where the plants are to stand, instead of the old mode of transplanting from a hot-bed. Time is thus saved, risks incidental to transplanting are avoided, and all the plants in the field start alike. Half a dozen seeds are scattered in each hill, so that the cut-worm has to depredate severely before he really injures the field. As the plants grow, the feeble ones can be thinned out, and where the seeds in an adjoining hill have failed to vegetate, the deficiency can be supplied by the superfluous healthy plants. Four to six ounces of seed thus planted in hills are sufficient for an acre.

Sprinkling wood ashes and air-slaked lime upon the young plants, while the leaves are damp with rain or dew, is an efficacious remedy for destroying the voracious fly, beetle, and flea that attack them as soon as they have broken through the soil, as well as for most other insects. Until the plants have a stump as large as a pipe-stem, they are subject to the ravages of the cut-worm, for which there seems to be no better remedy than sprinkling liberally wood ashes or air-slaked lime close about the stems of the plants. As this pest disappears about the middle of June, cabbages that are planted late suffer but little from it.

A cabbage-field should be stirred with the cultivator and hoe at least three times during their growth; the oftener the better. In the comparatively mild climate of England, cabbages are left unprotected in the fields during the winter months; and in the Southern States they are principally a winter crop. As we proceed north, a slight covering of litter on their heads is necessary. In New England they are placed in dry pits, several tiers deep, heads downward, about as thick as they will stand, covered with six inches of straw or coarse hay, with a roof

of rough boards, and about a foot of earth. Repeated freezing and thawing, or excessive moisture or warmth, will cause them to rot; while the dry air of most cellars abstracts moisture from the leaves, causing them to wilt and injuring their flavor.

For successive crops on a large scale for market, the following varieties are recommended: Early Wyman, Carter's Superfine Early, Little Pixie, Early Wakefield, Early Low Dutch, Early Winnigstadt, Early Schweinfurt, Premium Flat Dutch, Stone Mason, Large Late Drumhead, Marblehead Mammoth Drumhead, Fottler's Drumhead, Drumhead Savoy, and American Green Globe Savoy. It is well to note a fundamental distinction between the Drumhead cabbage of England and that of this country. In England the Drumheads are coarse, and are raised almost wholly for stock, being very different from the tender, succulent varieties of Drumheads raised here.

Cauliflowers, Brussels sprouts, and kale, in the selection of the soil and manure, and in cultivation, require generally the same treatment as cabbages.

HOW CROPS FEED: A treatise on the atmosphere and the soil, as related to the nutrition of agricultural plants. With illustrations. By Samuel W. Johnson, M. A., professor of analytical and agricultural chemistry in the Sheffield Scientific School of Yale College, chemist to the Connecticut State Agricultural Society, and member of the National Academy of Sciences. 12mo., pp. 375. New York: Orange Judd & Co., 1870.

Professor Johnson's able work, "How Crops Grow," noticed in the annual report of this Department for 1868, has been received with great favor, not only in America, but in Europe. It has been republished in England under the joint editorship of Professors Church and Dyer, of the Royal Agricultural College at Cirencester; and a translation into German will soon appear, on the recommendation of Professor Von Liebig. In this new work, "How Crops Feed," designed as the complement and companion of the former, the author has digested the cumbrous mass of evidence in which the truths of vegetable nutrition lie buried beyond the reach of ordinary inquirers, and has set these truths forth in proper order and plain dress for their legitimate uses.

Under the general divisions of the atmosphere as related to vegetation, and of the soil as related to vegetable production, Professor Johnson discusses the atmosphere as physically related to vegetation; also the origin and formation of soils; their definition, classification, and physical character; the soil as a source of food to crops, describing the ingredients the elements of which are of atmospheric origin, and such as are derived from rocks. He says:

> No study can have a grander material significance than the one which gives us a knowledge of the causes of the fertility and barrenness of soils; a knowledge of the means of economizing the one and overcoming the other, and of those natural laws which enable the farmer so to modify and manage his soil that all the deficiences of the atmosphere or the vicissitudes of climate cannot deprive him of a suitable reward for his exertions.

In remarking on the formation of nitrogenous compounds in the atmosphere, the fact, known to the best farmers, is stated, that certain crops are especially aided in their growth by nitrogenous fertilizers, while others are comparatively indifferent to them. Thus—

> The cereal grains and grasses are most frequently benefited by applications of nitrate of soda, Peruvian guano, dung of animals, fish, flesh, and blood manures, or other matters rich in nitrogen. On the other hand, clover and turnips flourish best, as a rule, when treated with phosphates and alkaline substances, and are not manured with animal fertilizers so economically as the cereals. It has, in fact, become a rule of practice in some of the best farming districts of England, where systematic rotation of crops is followed, to apply nitrogenous manures to the cereals, and phosphates to turnips.
>
> The foliage of clover, cut green, and of root crops, maintains its activity until the

time the crop is gathered: the supply of nitrates thus keeps pace with the wants of the plant. In the case of green crops, the functions of the foliage decline as the seed begins to develop, and the plant's means of providing itself with assimilable nitrogen fail, although the need for it still exists. Furthermore, the clover cut for hay leaves behind much more roots and stubble per acre than green crops, and the clover stubble is twice as rich in nitrogen as the stubble of ripened grain. This is a result of the fact that the clover is cut when in active growth, while the grain is harvested after the roots, stems, and leaves have been exhausted of their own juices to meet the demands of the seed. * * * The fact is not to be denied that the soil is enriched in nitrogen by the culture of large-leaved plants, which are harvested while in active growth, and leave a considerable proportion of roots, leaves, or stubble on the field. On the other hand, the field is impoverished in nitrogen when grain crops are raised upon it.

In the conversion of rocks into soil, the action of freezing water is remarkable. Water, in the act of conversion into ice, expands one-fifteenth of its bulk, and the force thus exerted is sufficient to burst vessels of the strongest materials, and, in cold latitudes or altitudes, accomplishes stupendous results.

Along the base of the vertical trap cliffs of New Haven and the Hudson River lie immense masses of broken rock, reaching to more than half the height of the bluffs themselves, rent off by this means. The same cause operates in a less conspicuous but not less important way on the surface of the stone, loosening the minute grains, as in the above instances it rends off enormous blocks. A smooth, clean pebble of the very compact Jura limestone, of such kind, for example, as abounds in the rivers of South Bavaria, if moistened with water and exposed over night to sharp frost, on the thawing is muddy with the detached particles.

Many interesting illustrations are given of the absorbent power of soils. Liquid manure is deodorized, decolorized, and rendered nearly tasteless by filtration through garden earth. It is a matter of common experience that a few feet or yards of soil intervening between a cess-pool or dung-pit and a well, preserves the latter against contamination for a longer or shorter period. The foul water of the Seine, at Paris, becomes potable after filtering through sandstone. These effects are not strikingly manifested by pure sand, but appear when clay is used. Solutions of coloring matters, such as logwood, sandal-wood, cochineal, litmus, &c., when shaken up with a portion of clay, are entirely deprived of color.

Garments which have been rendered disgusting by the fetid secretions of the skunk, may be "sweetened," *i. e.*, deprived of odors by burying them for a few days in the earth. The Indians of this country are said to sweeten the carcass of the skunk by the same process, when needful, to fit it for their food. Dogs and foxes bury bones and meat in the ground, and afterward exhume them in a state of comparative freedom from offensive odor.

When human excrements are covered with fine dry earth, as in the earth-closet system, all odor is at once suppressed and never reappears. At the most, besides an "earthy" smell, an odor of ammonia appears, resulting from decomposition, which seems to proceed at once to its ultimate results without admitting the formation of any intermediate offensive compounds. * * * These examples sufficiently prove that the soil, even sand, possesses the property of attracting and fully absorbing the extractive matters, so that the water which subsequently passes is not able to remove them: even the soluble salts are absorbed, and are washed out only to a small extent by new quantities of water.

Professor Johnson concludes this volume with remarks on the significance of the absorptive quality, in which he remarks that disintegration and nitrification would lead to a waste of the resources of fertility, were it not for the conserving effect of those physical absorptions and chemical combinations and replacements which have been described.

The great beneficent law regulating these absorptions appears to admit of the following expression, viz: Those bodies which are most rare and precious to the growing plant are by the soil converted into, and retained in, a condition not of absolute, but of relative insolubility, and are kept available to the plant by the continual circulation in the soil of the more abundant saline matters.

The soil, speaking in the widest sense, is then not only the ultimate exhaustless source of mineral (fixed) food to vegetation, but it is the storehouse and conservatory

of this food, protecting its own resources from waste and from too rapid use, and converting the highly soluble matters of animal exuviæ as well as of artificial refuse (manures) into permanent supplies.

The author is preparing another volume on a number of topics connected with the feeding of crops, which have not been treated upon, and which will naturally find their place in a discussion of the improvement of the soil by tillage and fertilizers.

TREES, PLANTS, AND FLOWERS; where and how they grow. A familiar history of the vegetable kingdom, by the author of "Our Own Birds," with seventy-three engravings. 12 mo., pp. 140. Philadelphia: J. B. Lippincott & Co.

This little book is intended to call attention to the beauties of creation. It gives the history and associations of the prominent trees of the world, as well as the leading grasses, flowers, alpine and aquatic plants and ferns, the contemplation of which is neglected because their appearance is so familiar. A description of the habits and uses of many plants is followed by an account of their discovery and introduction; as, for instance, the Victoria Regia, with its singular beauty and remarkble size, having leaves six feet in diameter. This plant was introduced into England from Bolivia in 1846, and is now to be found in several conservatories in this country, as well as in Europe. England abounds in trees of historic interest, some of which, there is good evidence to show, are upwards of one thousand years old. But there are few trees that attain the gigantic proportions and the age of the California pines. By counting the annual rings, it is proved that some of the oldest had been growing for three thousand years. As there is no good reason to doubt the accuracy of this computation, they must certainly have existed in the days of the Prophet Elijah; or even, as Dr. Lindley observes of one of them, "It must have been a little plant when Samson slew his Philistine." The uses and associations of the palms, cedars, oaks, pines, magnolias, &c., are given, forming a volume of much interest.

SEVENTY-FIVE FLOWERS, and how to cultivate them. By Edward Sprague Rand, jr., author of "Flowers for the Parlor and Garden," "Garden Flowers," "Bulbs," &c. 12 mo., pp. 210. J. E. Tilton & Co., 1870.

Under this modest title Mr. Rand has furnished a valuable book, with particular descriptions of seventy-five genera of flowers that are grown with the least care, and which will well repay the cultivator by their beauty and fragrance. They are plants that can be easily obtained, and will grow freely and bloom well in common soil. The descriptions of the individual flowers are preceded by general directions for preparing the soil, planting, and propagating, on which subjects many of the old works on horticulture contain much needless mystery. For instance, it formerly seemed necessary in cultivating even a small flower garden that a person should have free access to a peat meadow, a sand-bank, and a wood-lot, to supply himself with the necessary peat, sand, and leaf-mold, which looked discouraging to a beginner. Now, while peat, meadow-mud, leaf-mold, well-rotted sods, and silver-sand are important ingredients in potting and garden culture, in general out-door gardening, they are not absolutely necessary, and most flowers may be grown to perfection without any of them. Very few garden plants require a peat soil, and none absolutely need the elaborate combinations generally prescribed.

To prepare a flower border, the soil should be excavated eighteen to twenty-four inches in depth. If the subsoil is gravel, throw in a few inches of leaves, pine needles, old straw, or any coarse litter, and then fill up the bed with the good loam usually found in most gardens and

fields, and raised slightly above the level of the surrounding ground. If the subsoil is a close clay, fill in two or three inches of small stones or gravel, before laying on the above covering of litter and loam. A liberal supply of thoroughly-rotted manure, well dug into the bed when first made, will keep it in good condition for years, if forked over with a digging-fork in the spring, the weeds kept down, and the soil frequently stirred through the summer. Beds for hyacinths, tulips, and other bulbs are benefited by a covering of two or three inches of fresh horse manure, or litter as it comes from the stable, put on just before the ground freezes, and raked off early in the spring. In growing bulbous roots, it is well to use one fifth common building sand; as, if the soil is too close, the bulbs are apt to rot, or to be thrown out of the ground by the frost.

Large growing herbaceous perennials should be set deep. The depth at which bulbs should be planted varies somewhat according to their size, from two to six inches, and even eight inches for very large lilies and crown imperials. In sowing annuals it is impossible to lay down exact rules, much depending on the size of the seed. Soaking the seed before sowing is not generally advisable, except in the case of large, hard seed, as Indian Shot, or those which are a long time in vegetating, as Globe Amaranthus. A great mistake is made in sowing or transplanting too thick; crowded plants never look well. One that is well grown will be more effective than a dozen crowded together, and give more and better bloom. Each plant should have room to develop its full proportions, and to show its foliage, often quite as beautiful as the flower, to advantage. Where herbaceous plants form too large clumps, and grow out of the ground, or die in the center, they should be divided and reset in early spring. Watering is not recommended, but when water is given, it should be applied in abundance, as close to the roots as possible, and the soil saturated. A slight surface watering is worse than none at all. When plants droop, a judicious shading from sunlight is preferable to watering. By a little care in planting, with an eye to a succession of bloom, a display of flowers can be kept up from May to November. In planting masses for effect, it is not wise to mix colors or even shades. Each mass should be of one color; and if of the same plant, uniformity of habit and bloom is secured. In ribbon borders or beds, the contrasts should be striking, and the bands never be allowed to run into each other.

The leaves of bulbs should *never* be cut off until they turn yellow; if removed earlier, it is at the expense of next year's flower; for the stronger the leaves are grown, the better will be the condition of the bulb. The flower-stalks of bulbs should be cut off as soon as the flower has faded. Winter protection is best given by a slight covering of litter or coarse manure. Evergreen boughs laid over plants are excellent for preventing the alternate freezing and thawing so destructive in winter to herbaceous plants.

After some general directions on the various modes of propagating plants, a list is given of the most desirable kinds, of easy culture, for a succession of flowers through the season, beginning with the modest snow-drop and ending with the Christmas-Rose, with its blooms, pure white and beautiful, when all around is dark and dead.

Mr. Rand concludes his directions for the management of a flower garden with these remarks:

The propagation of plants is most interesting, both in study and practice. It is the creation of new individuals, which, while generally partaking of the characteristics of the parents in the case of seedlings, varies most wonderfully, and continually gives new sources of pleasure.

Hybridization is one of the most fascinating occupations. Its results sometimes seem miraculous, and the pleasure is ever new and ever changing.

A garden is a constant amusement; a happy combination of work and play. A study and a recreation; a source of health both for body and mind, whence one goes forth stronger and better, like the fabled Antæus, having renewed his strength by touching his mother earth.

Gray's School and Field Book of Botany: consisting of "Lessons in Botany," and "Field, Forest, and Garden Botany," bound in one volume. By Asa Gray Fisher, professor of natural history in Harvard University. 12 mo., pp. 622. New York: Ivison, Phinney, Blakeman & Co., 1870.

This is a new edition of a work that for years has been known as a standard authority. It combines in one volume the "Lessons in Botany," and the "Field, Forest, and Garden Botany," forming a popular and comprehensive school treatise for beginners, as well as for advanced classes in agricultural colleges and schools. It is a useful hand-book, also, to assist in analyzing plants and flowers in the field-study of botany, either by classes or individuals. Beginning with first principles, it progresses by easy steps, until the student is enabled to master the intricacies of the science. The "Field, Forest, and Garden Botany," comprises popular as well as strictly scientific descriptions of the common herbs, shrubs, and trees of the Southern as well as the Northern and Middle States, and all that are commonly cultivated, or planted for ornament, or use in fields, gardens, pleasure grounds, or in house-culture, including the plants ordinarily found in the conservatory.

Hearth and Home Book of Poultry: a practical and popular treatise on hens, turkeys, geese, and ducks: suited to the every day needs of the farmer, breeder, and fancier. 12 mo., pp. 50. New York: Pettingill, Bates & Co., 1870.

This little book describes eight or ten of the leading kinds of poultry that have been brought to notice during the last twenty-five years which are raised for profit, and about as many that are raised by "fanciers," for variety and the embellishment of their farm-yards. Although at their first introduction many of the breeds were sold at fabulous prices, there is no doubt that the Brahmas, Cochins, Crève-coeurs, Hamburgs, &c., have been the means of materially improving the marketable quality of the old-fashioned barn-yard poultry of the country. In fact, these extravagantly high prices have awakened great interest in the subject, and have been the means of introducing the best breeds of Europe and Asia. While it is unnecessary to describe their peculiarities, an abstract is given of the author's directions for the management of poultry.

A poultry-house should be located on gravel, or dry sandy loam. Standing or stagnant water is always to be avoided. A southern or southeastern aspect is the best; and if the yard can be located on a side-hill, with the house crowning its topmost point, all the better. Warmth, dryness, and pure air are indispensable. The sides and roof of the house must be impervious to water; but it should be so contrived as to admit of thorough ventilation and easy means of cleaning it once or twice a week. Its size should allow about six square feet for each fowl, and no apartment of any house should contain more than fifty fowls, unless they can be allowed at least double this space.

Fowls should be permitted to range at liberty a few hours daily, at least eight months in the year; and they require both animal and vegetable food. The roosts must be easy of access, and be reached mainly by steps instead of flight, and be of poles about two inches in diameter; and the nests should be kept dark and so placed that the hens can reach them unperceived, and lay without fear of disturbance. The floor should be

wholly of earth, or earth and cement, and the house never without boxes of dry ashes, and, if possible, a stream of running water or troughs regularly filled with fresh water daily.

At least once a week the whole of the surface of the yard should be turned over or loosened with the tines of a heavy manure-fork, so that everything that would emit unhealthy odors may be covered or incorporated with the deodorizing particles of the earth; or, still better, turn over a portion each day, so that the hens can have a little new space where they can daily find fresh gravel and other substances needful for health. Every month the whole surface, to the depth of three inches, should be removed, and its place supplied with fresh earth from outside. Ten fowls thus cared for will furnish ample manuring material for a small garden, while fifty will suffice to manure well half an acre.

Fowls overfat, or lean, seldom lay. Food that will keep them in the best working trim, as is said of an ox or horse, is the best; and they should be fed at regular hours with inexorable precision, say with a ground mixture of oats, buckwheat, barley and corn, in the morning, and whole corn and buckwheat at night, for three days in succession, and then a mixture of Indian meal one part, and boiled potatoes three parts for the fourth day, and so on through the year. With this, if the hens are shut up, they should be fed with some kind of meat, and green food, as grass, cabbage-leaves, beet-tops, &c., in season; and, to secure the greatest return, fresh oyster shells (pounded) each day in abundance. In winter the house must be kept closed, unless for an hour or two in the middle of a warm day.

Hens should have a separate place in or about the poultry-house, for sitting purposes, as whenever one commences her incubation there is always an inclination among the others in the same apartment to disturb her and lay in the same nest. Hens are inclined to sit where they have laid, and, if removed, will sometimes leave the newly-made nest. Before the eggs are put under the hen every particle of old straw should be removed, the nest box thoroughly cleaned, fresh hay substituted, and a little sulphur sprinkled in it; twelve eggs for the largest hens and nine for the smallest, will be sufficient. After the incubation has commenced never touch the hen or the eggs; nor, what is worse, disturb the nest. It is as bad as digging up a kernel of corn every day to see if it has sprouted. Place food where it will be accessible, give free range, keep other fowls and marauding animals away, and let her and her eggs and nest alone. The chickens should appear the twenty-first day, and the mother knows best when to abandon her nest with her young brood. The best food for young chickens is a mixture of hard-boiled egg and coarse-ground corn meal; or, at the outset, dry bread reduced to a proper form by being run through a coffee-mill. They should be fed sparingly every two hours, and kept dry and warm in cold weather.

Well-protected and carefully-managed hens have but few ailments; even the gapes, the most fatal disease among young chickens, is seldom known where the young are brooded on a dry surface and are not permitted to wander where they would be exposed and overcome by the cold, or by wet grass. Vermin must be exterminated by washing the rooms with lime water.

In raising turkeys they should be proportioned about ten or twelve hens to one cock. To save the trouble of watching them while seeking nests, prepare a yard of one-eighth of an acre for every fifteen birds, wherein nothing else is allowed to go. The best arrangement for a nest is small houses, about three feet by three, gable-shaped, and three feet high in the center. Nests should be scattered about the yard, and, if con-

venient, partially hidden by brush. Turkeys begin to lay in April, and if two or three incline to one nest, set another box at right angles and adjoining the one they covet. Take away the eggs every night, and place them in parcels of sixteen or eighteen. Set several turkeys at the same time, as half a dozen flocks can be as easily cared for as one, and those hatched and taken off about the same time usually run together without fighting. As soon as they leave the nest they should have a yard twelve feet square for every two turkeys, by setting up boards, a foot wide, endwise. The mother must be washed with tobacco-juice, and the young chickens dusted with snuff, to kill the lice; or sulphur and snuff, mixed in equal parts, sprinkled over the nest soon after the turkey begins to sit, and, as opportunity affords, dust the turkey herself. The young ones must be fed sparingly, at intervals of an hour, with coarse-ground Indian meal mixed with scalded sour milk curds, and fine-chopped hard-boiled eggs; in six or eight weeks they will be able to master a whole kernel. They require watching for two or three weeks after being turned into the fields, lest they wander into heavy, wet grass and perish; and should be driven up every night and shut into a stable or barn. They will soon get accustomed to coming home, and in due time will aspire to a roost.

A good combination in raising geese is one gander to two or three geese. In winter they require little or no shelter, and by early spring must have access to a running stream. Each goose requires a little house of its own, with five or six inches of dry horse-manure spread over the bottom, and a quantity of hay cut to two or three inches in length. The goslings appear in twenty-eight days, and if the spring grass is started, all they need is shelter from heavy, cold winds. If there is no grass they should have ordinary corn meal dough, and during the summer they should be turned into a pasture of short, tender grass, having a pond or running stream. An artificial pond, six feet by ten, its bottom covered with sand and pebbles, to the depth of two or three inches, is ample for a dozen geese or five times as many goslings, if the water is changed daily.

Ducks are hardy, and will eat almost anything. They need a range, and must have water. Four ducks are allowed to one drake. They should have a lodging place separate from barn-yard fowls. They begin to lay early in the spring; and the period of incubation varies from twenty-six to thirty days.

Harris on the Pig: breeding, rearing, management, and improvement. By Joseph Harris, Moreton Farm, Rochester, New York. 12mo., 250 pp. New York: Orange Judd & Co., 1870.

In this work the author endeavors to show that farmers can obtain more meat from a well-bred pig, in proportion to the food consumed, than from any other domestic animal. Paradoxical as it may seem, he asserts that consumers in our large cities are obliged to pay more for flesh-meat than it is intrinsically worth, while farmers, with the exception of those who produce beef and mutton of the very best quality, make nothing by raising and feeding cattle and sheep. While they receive more for their meat than it is really worth, it has cost them more than they get for it. The remedy for this state of things will be found in more thorough cultivation, in growing better grasses, in keeping better stock, and particularly in more liberal feeding.

A farmer who once uses a thorough-bred boar, and adopts a system of liberal feeding, will find that he can produce better pork, at a far less cost, than when he uses a common boar. The author considers it im-

portant to get a breed of pigs that will eat, digest, and assimilate a large amount of food, and gives reasons for this opinion, citing some experiments that confirm it. It is a great point with the author to induce farmers to so breed and feed their hogs that they will be in the pork-barrel long before they attain the age of an old-fashioned hog.

The first step of importance in breeding pigs is the selection of a refined, thorough-bred boar. In raising pigs for the butcher, it is not necessary that selection be limited to any particular breed; but the selection must be made with reference to the points whether the pigs are to be fattened and sold when a few months old for fresh pork, or to be kept until they have nearly attained their growth before being fattened, and whether large hogs are wanted, or smaller and finer ones at a less age. Much depends also upon the sow to be bred from. It is an easy matter to find strong, vigorous sows of good size in any neighborhood where the Chester White or similar large breeds have been introduced. Select the largest, thriftiest, and best-formed sows; put them to a good, thorough-bred boar; let the sow be regularly and liberally fed, without making her too fat. One that has been half starved all her life cannot produce pigs of good size, and with a tendency to grow rapidly and mature early. The small breeds mature earlier than the large ones, which is in itself a great advantage, as the pigs are not only ready for the butcher at an earlier age, but as animal life is always attended by a constant transformation of tissue, every day we gain in time saves the amount of food necessary to supply this waste and keep up the animal heat. Some farmers half starve their breeding sows, from a notion that it improves their breeding and suckling qualities, just as some dairymen think a cow must be kept poor if she is to be a good milker; a mistake of the cause for the effect. The cow is thin because she is a good milker, and not a good milker because she is thin. So a good sow gets very thin in suckling her pigs; but it is a great mistake to keep her thin in order to make her a good breeder and suckler.

In raising improved, thorough-bred pigs, it is a great object to get a breed that will grow rapidly and mature early; and the better the breed the more rapidly they will grow. A thorough-bred boar should be procured from some reliable breeder, and put to the largest and best sows the farmer has. A highly-refined, thorough-bred boar, at six or eight weeks old, can usually be bought for $20 to $25. Such a boar in a neighborhood is capable of adding $1,000 a year to the profits of the farmers who use him.

Mr. Harris concludes his book with the following summary of the facts and principles discussed:

The leading breeds of English pigs are the Berkshire, Essex, and Yorkshire. The Essex are entirely black the Berkshire are also dark-colored pigs, but not so black as the Essex, and have also white spots on the head and feet. There are large and small Berkshires. The Yorkshires are white, but occasionally dark spots show themselves on the skin, which are not considered decisive evidence that the pigs are not thorough-bred. There are small, medium, and large or mammoth Yorkshires.

The Essex, at maturity, will dress from four hundred to four hundred and fifty pounds. They are the largest of the small breeds. Berkshires often exceed this weight; but when such is the case, they would be classed as large Berkshires. The Prince Albert Suffolks are small Yorkshires.

The leading breeds, originating in the United States, are the Cheshires, or Jefferson (New York) County, the Chester Whites, or Chester (Pennsylvania) County, and the Magie, or Butler (Ohio) County pigs. The China-Polands, or China and Big Polands, are said to be the same breed as the Magie, or Butler County. The Illinois Swine Breeders' Association, at its meeting in 1870, resolved to call them the Magie breed. They are a large, coarse breed, with black and white and occasionally sandy spots. Like the Chester Whites, they will doubtless afford splendid sows for crossing with the Essex, Berkshire, or other refined thorough-bred boars. The Jefferson County are a very handsome white breed, essentially Yorkshires.

Pigs should always have access to fresh water. No matter how sloppy the food is, or how much dish-water is furnished, they should always be supplied with pure water. We are satisfied that pigs often suffer for want of it.

Salt, sulphur, charcoal, ashes, bone-dust, or superphosphate should occasionally be placed where the pigs can eat what they wish of them.

Pigs will eat beans, if *thoroughly* boiled, though they are not fond of them. Peas they eat with avidity, and, when as cheap as corn, should be fed in preference, as they afford much the richer manure. Half peas and half corn, are probably better than either alone. Peas make very firm pork.

Oil-cake, when fed in large quantities, injures the flavor and quality of the pork, but we have fed small quantities of it with decided advantage to the health and rapid growth of the pigs, without any apparent injury to the lard or pork. It is quite useful for breeding-sows. It keeps the bowels loose, and increases the quantity and quality of the milk.

Bran, except in small quantities, is not a valuable food for fattening pigs. It is too bulky. But when rich, concentrated food is given, such as corn, barley, peas, or oil-cake, pigs should be allowed all the bran they will eat, placed in a separate trough. In this way it becomes a very useful and almost indispensable article to the pig feeder. It is also very useful for breeding-sows. The best roots to raise for pigs are parsnips and mangel-wurzel.

The period of gestation in a sow is almost invariably sixteen weeks. In three or four days after pigging, a sow in good condition will generally take the boar. But, as a rule, it is not well to allow it. If she passes this period, she will not take the boar until the pigs are weaned. If she fails the first time, she will "come round again" in from two to three weeks.

For mild cases of diarrhea, nothing is better than fresh-skimmed milk, thickened with wheat flour.

Pigs should be castrated a week or two before they are weaned.

Nothing in the management of pigs is more important than to provide a trough for the sucking pigs separate from the sow, and to commence feeding them when two or three weeks old.

Many of the diseases of pigs are contagious, and the instant a pig is observed to be sick it should be removed to a separate pen; and it would be well to regard this single case of sickness as an indication that something is wrong in the general management of the pigs. Clean out the pens, scald the troughs, scrape out all decaying matter from under and around them, sprinkle chloride of lime about the pen, or, what is probably better, carbolic acid. Dry earth is a cheap and excellent disinfectant. Use it liberally at all times. Whitewash the walls of the pens. Wash all the inside and outside wood-work, troughs, plank floors, &c., with crude petroleum. It is the cheapest and best antiseptic yet discovered.

To destroy lice, wash the pig all over with crude petroleum, and the next day give him a thorough washing with warm water and soap, with the free use of a scrubbing-brush.

Pigs should be provided with scratching-posts, having auger holes bored for pegs at different heights, to accommodate pigs of different sizes.

The following description may be considered the perfection of form in a fat pig: The back should be nearly straight, though being arched a little from head to tail is no objection; the back uniformly broad and rounded across along the whole body; the touch along the back should be firm, but springy, the thinnest skin springing most; the shoulders, sides, and hams should be deep perpendicularly, and in a straight line from shoulder to ham; the closing behind filled up; the legs short and bone small; the neck short, thick, and deep; the cheeks round and filled out; the face straight, nose fine, eyes bright, ears pricked, and the head small in proportion to the body; a curled tail is indicative of a strong back.

The appendix contains several letters from experienced breeders in England, Canada, and this country, on the breeding and management of swine.

THE PHOSPHATE ROCKS OF SOUTH CAROLINA, AND THE GREAT CAROLINA MARL BED; with five colored illustrations. A popular and scientific view of their origin, geological position, and age; also, their chemical character and agricultural value: together with a history of their discovery and development. By Francis S. Holmes, A. M., of Charleston, South Carolina, late professor of geology and paleontology in the College of Charleston. 8vo, 87 pages. Charleston, South Carolina: Holmes's Book House, 1870.

As the scientific character and great value of the immense phosphate beds of South Carolina were amply discussed in the last two annual reports of this Department, an abstract is now given merely of the history of their discovery and development, and present condition.

An extract from Judge Drayton's "View of South Carolina," published in 1802, shows that their existence has been known for seventy years; but in the state of geological science at the beginning of this century a knowledge of their extreme richness in phosphate of lime and great importance in renovating the exhausted fields of the South was wanting. Thirty years ago Professor Holmes had his attention attracted to the nodules or rocks scattered over the old rice-fields on the banks of the Ashley, near Charleston, that were generally considered useless, and were gathered into heaps, so as not to interfere with cultivation. Careful study soon convinced him of their great value as fertilizers. The appointment of Mr. Ruffin, in 1842, to make a geological and agricultural survey of the State, awakened public attention to them. In 1860 Professor Shepard, appreciating their value, urged upon agricultural societies the importance of utilizing them. The war of the rebellion soon following, the public mind was wholly attracted to its objects, and the phosphates were neglected. In 1867 Professor Holmes and Dr. Pratt satisfied themselves of their great value, and after unavailing efforts to obtain means in Charleston to develop them, resorted to the North for aid, and over $6,000,000 are now invested by northern capitalists in mining the rocks and manufacturing them into rich fertilizers. The business is rapidly extending, and is divided among about twenty companies, the largest of which has a capital of $800,000, and is chiefly owned in Philadelphia. As in all pioneer enterprises, many difficulties had to be surmounted by the first company:

It was a new and untried field; thousands of dollars were expended before the proper mode of working "the diggings" could be known. Laborers were scarce, and the negro, unaccustomed to such work, accomplished very little toward a day's task. The best time for mining was during the summer or dry season of the year, when the white laborer could not withstand the chills and fever of the season; in a word, difficulties and opposition arose every day and in every form. Where the company expected to keep employed one thousand laborers, thirty could not be placed. The thing could not be done in a day; time was required to develop and work out the problem. And perhaps it was well; for had very great quantities of the raw material been suddenly put upon the market, a substance new and untried, no one can tell what would have been the result. Time was required for the manufacturers of fertilizers to test the new material. But now that they have done so at the North, East, South, and West, in England, Scotland, Ireland, Germany, France, and Spain, the demand for the raw material has increased twenty-fold.

ANNALS OF BEE-CULTURE, for 1870: A Bee-Keeper's Year Book. D. L. Adair, editor, Hawesville, Kentucky. With communications from the best apiarians and naturalists. 12mo., 64 pages. Louisville, Kentucky: C. Y. Duncan, printer, 1870.

There are now five monthly journals published in this country exclusively devoted to the management of bees, showing an extraordinary increase of interest in this subject within a few years. Many improvements have been made in the construction of hives, and new breeds of bees introduced, of which the Italian seems to stand highest in repute. Besides the preceding journals, Mr. Adair publishes annually a little volume filled with original articles on this subject by distinguished apiarians and naturalists, as well as translations from European bee journals. The present volume has about thirty articles on "The principles of bee-keeping;" "The value of the honey-bee in agriculture;" "Women as bee-keepers;" "The bee-moth;" "Artificial swarming;" "Alsike clover;" "Proceedings at the sixteenth anniversary of bee-keepers at Nuremberg, Germany, last year," (in the environs of which apiarians have more than three thousand hives); "European bee-culture," &c. From the valuable contribution of Dr. Packard, on the value of the honey-bee in agriculture, we make the following extracts:

Of what use is the bee? our readers may ask. The answer will recur to but few. The grand use in nature of the bee is the securing to the farmer or fruit-raiser a

good crop, and the permanence of the best varieties of fruit. Gardeners have always known that bees fertilize squash, melon, and cucumber flowers, by conveying the pollen from one plant to another, thus insuring not only the complete fertilization of the seed by the male pollen and improving the fruit, but actually causing the production of more squashes, melons, and cucumbers, by causing certain flowers to set that otherwise would have dropped to the ground sterile and useless. This has been proved by fertilizing the flowers by hand; a very large, indeed an unnaturally abundant crop being thus obtained. It has been noticed by a few, though the many have not appreciated the fact, that fruit trees are more productive when a swarm of bees is placed among them, for when the bees have been removed by disease or other means, the fruit crop has diminished.

In answer to the question whether bees are in any way injurious to fruit or lessen the quality or quantity, I would reply that all the evidence given by botanists and zoölogists, who have specially studied this subject, shows that bees improve the quality and tend to increase the quantity of the fruit. They aid in the fertilization of flowers, thus preventing the occurrence of sterile flowers, and, by more thoroughly fertilizing flowers already perfect, render the production of sound and well-developed fruit more sure. Many botanists think if it were not for bees and other insects, (such as certain two-winged flies, moths, wasps, &c.,) many plants would not fruit at all. * * * It is alleged that bees do injury in some way by extracting the honey from flowers. What is the use in nature of honey? The best observers will tell you that it is secreted by the plant for the very purpose of attracting bees to the flower; otherwise it is of no use to the flower or fruit.

At the Apiarian General Convention, held at Stuttgardt, in Wurtemberg, in September, 1858, the subject of honey-yielding crops being under discussion, the celebrated pomologist, Professor Lucas, one of the directors of the Hohenheim Institute, alluding to the prejudice that the bee injures the fruit by its visits to the flowers, said: "Of more importance, however, is the improved management of our fruit trees. Here the interests of the horticulturist and the bee-keeper combine and run parallel. A judicious pruning of our fruit will cause them to blossom more freely and yield honey more plentifully. I would urge attention to this on those more particularly who are both fruit-growers and bee-keepers. A careful and observant bee-keeper at Potsdam writes to me that his *trees yield decidedly larger crops since he has established an apiary in his orchard, and the annual crop is now more certain and regular than before*, though his trees had always received due attention."

Some years ago, a wealthy lady in Germany established a green-house, at considerable cost, and stocked it with a great variety of choice native and exotic fruit trees, expecting in due time to have remunerating crops. Time passed, and annually there was a superabundance of blossoms, with only very little fruit. Various plans were devised and adopted to bring the trees to bearing, but without success, till it was suggested that the blossoms needed fertilization, and that by means of the bees the needed work could be effected. A hive of honey-gatherers was introduced next season; the remedy was effectual: there was no longer any difficulty in producing crops there. The bees distributed the pollen, and the *setting* of the fruit followed naturally.

Mr. A. J. Cook, secretary of the Michigan Bee-Keepers' Association, recommends placing the hives in a grove or orchard, about four inches from the ground, the stand projecting some distance in front, with an inclining board reaching from this to the ground. If the hive is placed ten to twenty feet high, as it sometimes is, the heavily-laden bee, when "homeward bound" in a high wind, cannot so readily reach it, and is more exposed to the king-bird, which darts from its perch on the tree with unerring certainty on the baffled bees. Mr. J. H. Townley, of Michigan, states that the general culture of the Alsike clover, distributed by the Department of Agriculture, which combines the good qualities of the red clover for hay and pasture with those of white clover for bees, will add immensely to the product of honey. This plant delights in a moist, rich soil, and shows very strikingly the beneficial effects of plaster.

1. THE AMERICAN AGRICULTURAL ANNUAL, for 1871. A farmer's year-book, exhibiting progress in agricultural theory and practice, and a guide to present and future labors. Illustrated. 12 mo., pp. 152. New York: Orange Judd & Co.

2. THE AMERICAN HORTICULTURAL ANNUAL, for 1871. A year-book of horticultural progress for the professional and amateur gardener, fruit-grower, and florist. Illustrated. 12 mo., pp. 152. New York: Orange Judd & Co.

These little works are handsomely printed and illustrated and filled

with valuable original articles by experienced writers. The leading articles in the former are upon agricultural inventions and novelties, describing the different labor-saving machines and implements brought into notice the past year; the progress of fish-culture; notes upon dairy matters; upon the diseases of cattle, horses, and poultry; leguminous plants; mutton sheep; besides numerous useful tables.

In the retrospect of the year it is stated that "coöperation among farmers has extended from the cheese dairies of Central New York over a large part of that State and westward into Ohio, Indiana, Illinois, and other western and interior States. Not only have cheese factories been on the increase, but in other matters farmers are slowly learning the advantages to be derived from a similar course of coöperation. Along the Housatonic Railroad a milk association offers unusual facilities for farmers to get a good price for their milk. Butter dairies or creameries are springing up in various parts of New England, and similar coöperation will obtain in regard to other farm products, making the farmers less dependent upon middlemen." The receipts of cheese at New York in 1870 show an increase of 43,000 boxes as compared with 1869, and the exports were more than 4,000,000 pounds in excess of the previous year. A patent style of square cheeses, of various sizes up to thirty pounds' weight, has been introduced into Otsego County, New York. The most desirable form is ten inches long and five square, weighing nine to ten pounds, and it is thought this form has some advantages in manufacture, packing, and preservation.

In fish culture a very substantial increase is noted, although not yet sufficient to affect the fish markets. It requires four or five years for shad or salmon to reach their best condition. Thus far it has only been attempted to sow the seed, and to demonstrate, in a limited way, the economy of stocking barren streams with fish. These efforts have been attended with so much success that men best acquainted with the results are entirely confident of the future of fish culture, and are willing to embark their capital in fish-hatching houses, in dams, and leases of ponds and streams. The legislatures of all the New England and Middle States have voted liberal appropriations and appointed fish commissioners to manage this new industry. Millions of ova of salmon, shad, black-bass, white-fish, trout, &c., have been placed in the rivers and ponds of the Northern States. In 1867 some millions of shad-spawn were placed in the Connecticut River, and in 1870 the catch was without parallel in late years, upward of 30,000 being taken last spring. At Holyoke, 450 were taken at one haul. The results are so satisfactory that upwards of 50,000,000 of fry have been placed in the Connecticut, at an expense of only $500 to the State; seventeen ponds in Connecticut have also been stocked with black-bass by the State, besides a large number by private enterprise. Numerous ponds and streams, farther north, are being stocked with trout.

Dr. Hexamer thinks the severe drought of 1869 and 1870 produced the beneficial result upon the potato crop of nearly exterminating the potato disease or rot, which was so destructive during several preceding years. Nearly all varieties grown in 1870 have kept well, and are of better quality than usual. The Early Rose has become the great favorite and fully sustains its reputation.

The Horticultural Annual is of a character similar to the Agricultural Annual, comprising articles on orange culture in Florida, on dwarfs, on conifers, on raising nursery trees from seeds, with notes on new fruits and the fruit crop of the year, as well as the new vegetables, roses, and other flowering plants that have been tested.

Both of these works are closed with a farmers' directory of all the leading nurserymen, florists, seedsmen, and dealers in farmers' and gardeners' materials.

THE PRAIRIE FARMER ANNUAL, for 1871, containing valuable information for western farmers, fruit-growers, and housewives, including a list of implement manufacturers and dealers, seedsmen, nurserymen, stock-breeders, &c. With illustrations. 18 mo., pp.144. Chicago, 1871. Prairie Farmer Company, print.

This is one of the useful books of the day, neatly and compactly printed and illustrated, and filled with practical information for farmers and housekeepers, and sold, withal, at a price bringing it within the means of every one. Its leading articles are on homes for the people, with plans, elevations, and estimates for building farmers' dwellings of different styles and sizes, costing from $500 to $2,000, with specifications for materials; on the management of lawns, ferneries, and kitchen-gardens; on strawberry culture; raising trees from seed; testing milk in cheese factories; raising calves; raising colts for the farm and road; breeding and fattening swine; poultry and poultry-houses; transplanting large trees; canning fruits; and various articles on household economy; besides a directory of all the principal nurserymen, seedsmen, manufacturers of agricultural implements, and stock-breeders and dealers in the United States, with various national and State statistics, &c.

To make a first-class lawn, Mr. Meehan says:

The ground should be heavily manured and plowed deep; grass holds on greener in a dry time when the soil is rich; and it is the beauty of a lawn to be always green. Frequent mowing gives a chance to the grass to keep green, which it does not get when it is seldom cut. This is owing to a law in vegetable physiology, that the length of the roots depends upon the growth of the tops. For instance, if we let grass grow eighteen inches, the roots may go down twelve; but if we never permit the grass to grow beyond nine, the roots will not penetrate six. Of course the roots absorb moisture from the soil. If the roots are not there, more moisture is held in reserve; and as the surface dries, the moisture below comes up to the place where it is wanted. A closely-mown lawn is a perpetual mulch, keeping the earth cool and moist below. Few will believe this unless they try it with a thermometer. An annual light dressing of salt is good to keep a lawn green in a dry time. If there is much extent of lawn, a hand-mower, costing about $35, is an excellent thing. With a few hours' work—say every two weeks—the lawn will acquire and retain a fine carpety look. As to the kinds of grass to grow, beware, above all, of lawn mixtures, which are much like patent medicines that contain about two cents' worth of good at two dollars' expense. Kentucky blue-grass (*Poa pratensis*) makes an excellent lawn; so does red-top, (*Agrostis vulgaris*.) Rye-grass (*Lolium perenne*) will not stand very close cutting in our climate.

Mr. Arthur Bryant, in view of the rapidly-increasing demand for lumber in the West, recommends that on every farm of forty acres or more, at least one-fifth should be set apart for timber. Lands for this purpose should be deeply plowed and rendered quite mellow. The seeds of the ash, oak, hickory, and tulip ripen in the fall, and should be then gathered, mixed with slightly-moist sand, and kept till spring in boxes, in a cool place, where they will be safe from rats and mice, and then be sown in beds or drills. Oaks, chestnuts, and beeches had better be planted where they are to remain, as they do not transplant well. The ash is a most valuable timber. In two years, and sometimes in one, the plants will be large enough to set out in rows, four feet apart, and two feet distant in the rows: these transplant easily. The seeds of both the silver and the red maple, and also of the elm, ripen in the latter part of May, and should be sown immediately; those of the other maples ripen in the fall, and should be preserved and managed like the ash, &c. The sugar and black maples grow slowly at first, and should remain for two or three years in the seed bed. The tulip tree should be planted in the spring and transplanted when two years old. It is a desirable tree, and

Downing says that in Europe it is considered the most beautiful of all American shade trees. Coniferous trees, as the spruce, larch, and pine, require more care and skill, and it is cheaper for a novice to buy the seedlings from professional growers than to try to raise them from seed. They can be purchased at cheap rates when twelve to eighteen inches high. He adds:

The sides of ravines, river bluffs, and hills too steep for cultivation may be planted with nuts, acorns, or young trees, with a garden-trowel or spade. The European larch is well suited to such situations. Thousands of farms include more or less land of this description, of little value for any other purpose than growing wood. Vegetation in such localities is usually thin, and young trees will thrive better without cultivation than on level lands. Bushes and rank weeds likely to interfere with their growth should be kept down. Farm stock must be carefully excluded from timber plantations. Not only so, but they should not be permitted to range in any woodland intended to be permanent. Under a persistent course of pasturage a forest will die out, while with proper care it will reproduce itself in all time.

AGRICULTURAL AND HORTICULTURAL PERIODICALS.

AGRICULTURIST AND HOME CIRCLE, Mexico. Missouri. Monthly, $1 per annum. W. G. Church & Co., publishers; W. G. Church, editor.

AMERICAN AGRICULTURIST, New York City. Monthly, $1 50 per annum. Issued in English and German. Orange Judd & Co., publishers; George Thurber, managing editor.

AMERICAN BEE JOURNAL, Washington, D.C. Monthly, $1 per annum. Samuel Wagner, publisher and editor.

AMERICAN FARMER, Baltimore, Maryland. Monthly, $1 50 per annum. Frank Lewis, publisher; N. B. Worthington, agricultural editor.

AMERICAN FARM JOURNAL, Toledo, Ohio. Monthly, 75 cents per annum. Miller, Locke & Co., publishers; William H. Busbey, editor.

AMERICAN RURAL HOME, Rochester, New York. Weekly, $2 per annum. A. A. Hopkins and G. F. Wilcox, publishers and editors.

AMERICAN STOCK JOURNAL, Parkesburg, Pennsylvania. Monthly, $1 per annum. N. P. Boyer & Co., publishers and editors; A. Marshall, associate editor.

ARKANSAS AGRICULTURAL AND MECHANICAL JOURNAL, Little Rock, Arkansas. J. S. Duffie & Co., publishers; John S. Duffie, editor.

BANNER OF THE SOUTH AND PLANTERS' JOURNAL, Augusta, Georgia. Weekly, $3 per annum. Chronicle Publishing Company, publishers; Henry Moore, A. R. Wright, and Patrick Walsh, editors.

BEE KEEPERS' JOURNAL AND NATIONAL AGRICULTURIST, New York City. Monthly, $1 per annum. H. A. King & Co., publishers; Homer A. King, Ellen S. Tupper, and I. V. Mapes, editors.

BONHAM'S RURAL MESSENGER, Chicago, Illinois. Monthly, $1 50 per annum. Jeriah Bonham, publisher and editor.

BOSTON CULTIVATOR, Boston, Massachusetts. Weekly, $2 50 per annum. Otis Brewer, publisher and editor.

CALIFORNIA FARMER, San Francisco, California. Weekly, $5 per annum. Warren and Co., publishers; Col. Warren, editor.

CALIFORNIA HORTICULTURIST AND FLORAL MAGAZINE, San Francisco, California. Monthly, $4 per annum. F. A. Miller & Co., publishers.

CAROLINA FARMER, Wilmington, North Carolina. Weekly, $3 per annum. William H. Bernard, publisher and editor; Robert K. Bryan, associate editor.

CENTRAL UNION AGRICULTURIST AND MISSOURI VALLEY FARMER, Omaha, Nebraska. Jeremiah Behm, publisher and editor.

CHAUTAUQUA FARMER, Forestville, New York. Weekly, $1 50 per annum. Parker and Russell, publishers; A. G. Parker, editor.

COLMAN'S RURAL WORLD, St. Louis, Missouri. Weekly, $2 per annum. Norman J. Colman, publisher and editor; William Muir and C. W. Murtfeldt, associate editors.

CULTIVATOR AND COUNTRY GENTLEMAN, Albany, New York. Weekly, $2 50 per annum. Luther Tucker and Son, publishers and editors; J. J. Thomas, associate editor.

DEITZ'S EXPERIMENTAL FARM, STOCK, AND POULTRY JOURNAL, Chambersburg, Pennsylvania. Monthly, $1 50 per annnm. George A. Deitz, publisher.

FARM AND GARDEN, Clinton, South Carolina. Monthly, $1 per annum. J. R. Jacobs & Co., publishers.

FARMER AND ARTISAN, Athens, Georgia. Weekly, $3 per annum. S. A. Atkinson, publisher; Daniel Lee, editor.

FARMER AND GARDENER, Augusta, Georgia. Semi-monthly, $1 per annum. E. H. Gray, publisher; P. J. Berckmans, horticultural editor.

FARMERS' GAZETTE AND INDUSTRIAL INDEX, Richmond, Virginia. Monthly, $1 per annum. S. Bassett French, publisher and editor.

FARMERS' HOME JOURNAL, Lexington, Kentucky. Weekly, $3 per annum. H. T. Duncan, jr., and Hart Gibson, publishers and editors.

FARMERS' UNION, Minneapolis, Minnesota. Monthly, $1 per annum. J. H. Stevens, publisher and editor; D. A. Robertson, F. D. Carson, W. A. Nimocks, associate editors.

FRUIT GROWER, Gilman, Illinois. Monthly, 50 cents per annum. Edward Rumley, publisher.

GARDENER'S MONTHLY, Philadelphia, Pennsylvania. Monthly, $2 per annum. Brinckloe and Marot, publishers; Thomas Meehan, editor.

GEORGIA FARM JOURNAL, Madison, Georgia. Weekly, $3 per annum. J. F. Shecut, publisher and editor.

GERMANTOWN TELEGRAPH, Germantown, Pennsylvania. Weekly, $2 50 per annum. Philip R. Freas, publisher and editor.

GRAPE CULTURIST, St. Louis, Missouri. Monthly, $2 per annum. George Husmann, editor.

HEARTH AND HOME, New York City. Weekly, $3 per annum. Orange Judd & Co., publishers.

HOME, FARM, AND ORCHARD, Newburgh, New York. Weekly, $1 per annum. A. A. Bensel, publisher and editor.

HORTICULTURIST, New York City. Monthly, $2 50 per annum. Henry T. Williams, publisher and editor.

ILLUSTRATED JOURNAL OF AGRICULTURE, St. Louis, Missouri. Monthly, $1 50 per annum. Wolcott and Marmaduke, publishers; Vincent Marmaduke and John S. Marmaduke, editors.

IOWA HOMESTEAD AND WESTERN FARM JOURNAL, Des Moines, Iowa. Weekly, $2 per annum. Mills & Co. and W. D. Wilson, publishers; W. D. Wilson, editor.

KANSAS FARMER, Leavenworth, Kansas. $1 per annum. G. T. Anthony, publisher and editor.

LIVE-STOCK JOURNAL, Buffalo, New York. Monthly, $1 50 per annum. Henry C. Springer & Co., proprietors; George A. Martin, publisher and editor.

MAINE FARMER, Augusta, Maine. Weekly, $2 per annum. Homer and Badger, publishers; S. L. Boardman, editor.

MARYLAND FARMER, Baltimore, Maryland. Monthly, $1 50 per annum. S. Sands Mills & Co., publishers.

MASSACHUSETTS PLOUGHMAN, Boston, Massachusetts. Weekly, $2 50 per annum. George Noyes, publisher.

MICHIGAN FARMER AND STATE JOURNAL OF AGRICULTURE, Detroit, Michigan. Weekly, $2 per annum. Johnstone and Gibbons, publishers; R. F. Johnstone, editor.

MIDDLE GEORGIA FARMER, Augusta, Georgia. Monthly. Central Georgia Real Estate Agency, publishers; J. Howard Brown, editor.

MIRROR AND FARMER, Manchester, New Hampshire. Weekly, $2 per annum. John B. Clarke, publisher and editor.

MISSISSIPPI AGRICULTURIST, Meridian, Mississippi. Monthly, $1 per annum. John H. Miller, publisher and editor.

MODEL FARMER, Corinth, Mississippi. Monthly, $1 50 per annum. Barr & Thompson, publishers; J. F. Thompson, editor.

MOORE'S RURAL NEW YORKER, New York City, and Rochester, New York. Weekly, $3 per annum. D. D. T. Moore, publisher and conducting editor; Charles D. Bragdon and Andrew S. Fuller, associate editors.

NATIONAL BEE JOURNAL, Indianapolis, Indiana. Monthly, $1 per annum. N. C. Mitchell, publisher.

NATIONAL FARMER AND HORTICULTURAL REGISTER, Philadelphia, Pennsylvania. Weekly, $1 per annum. Brinckloe & Marot, publishers; W. G. Brinckloe, editor.

NATIONAL LIVE-STOCK JOURNAL, Chicago, Illinois. Monthly, $2 per annum. Geo. W. Rust & Co., publishers; John P. Reynolds, editor; J. H. Sanders, associate editor.

NEW ENGLAND FARMER, Boston, Massachusetts. Monthly, $1 50 per annum. R. P. Eaton & Co., publishers; Simon Brown and S. Fletcher, editors.

NEW ENGLAND FARMER, Boston, Massachusetts. Weekly, $2 50 per annum. R. P. Eaton & Co., publishers; Simon Brown, agricultural editor; S. Fletcher, assistant editor; Russell P. Eaton, general editor.

NEW ENGLAND HOMESTEAD, Springfield, Massachusetts. Weekly, $2 50 per annum. Henry M. Burt & Co., publishers and editors; A. P. Peck, associate editor.

NORTHERN FARMER, Janesville, Wisconsin. Weekly, $1 50 per annum. O. F. Stafford, editor.

NORTHWESTERN FARMER, Indianapolis, Indiana. Monthly, $1 per annum. T. A. Bland, publisher and editor.

OHIO FARMER, Cleveland, Ohio. Weekly, $2 per annum. G. E. Blakeley, publisher and editor.

OUR HOME JOURNAL, New Orleans, Louisiana. Weekly, $3 per annum. James H. Hummell, publisher.

PACIFIC RURAL PRESS, San Francisco, California. Weekly, $4 per annum. Dewey & Co., publishers; W. B. Ewer, principal editor.

PLANTATION, (THE,) Atlanta, Georgia. Weekly, $3 per annum. T. C. Howard, editor; R. A. Alston, assistant and corresponding editor.

PIONEER FARMER, Sioux City, Iowa. Monthly $1 50 per annum. A. L. Northup, published editor.

PLEASANT VALLEY FRUIT AND WINE REPORTER, Hammondsport, New York. Semi-monthly, $1 per annum. A. L. Underhill, publisher and editor; Dr. E. Van Keuren, T. M. Younglove, and Mrs. B. Bennett, associate editors.

PRACTICAL FARMER, Philadelphia, Pennsylvania. Monthly, $1 50 per annum. Paschall Morris & Co., publishers; Paschall Morris, editor.

PRACTICAL PLANTER, Memphis, Tennessee. Monthly, $1 50 per annum. Geo. W. Gift, editor.

PRAIRIE FARMER, Chicago, Illinois. Weekly, $2 per annum. Prairie Farmer Company, publishers; Henry D. Emery, editor, assisted by W. W. Corbett, H. T. Thomas, Rodney Welch, and Dr. E. S. Hull.

RECONSTRUCTED FARMER, Tarboro', North Carolina. Monthly, $2 per annum. James R. Thigpen, publisher and editor.

ROCK RIVER FARMER, Dixon, Illinois. Monthly. W. M. Kennedy, publisher; W. H. Van Epps, editor.

RURAL AMERICAN, New York City. Weekly, $2 50 per annum. T. B. Miner & Co., New Brunswick, New Jersey, publishers and editors.

RURAL CAROLINIAN, Charleston, South Carolina. Monthly, $2 per annum. Walker, Evans & Cogswell, and D. Wyatt Aiken, publishers; D. H. Jacques, editor.

RURALIST AND OHIO VALLEY CULTIVATOR, Cincinnati, Ohio. Monthly, $1 per annum. J. S. Sheppard & Co., publishers; J. S. Sheppard, editor.

RURAL MESSENGER, Petersburg, Virginia. Weekly, $2 per annum. Ege, Bozel & Rogers, publishers; Thomas S. Pleasants, editor.

RURAL SOUTHERNER, Atlanta and Augusta, Georgia. Monthly, $1 per annum. Samuel A. Echols, publisher and editor; Andrew J. Beck, associate editor.

RURAL SOUTH LAND, New Orleans, Louisiana. Weekly, $3 per annum. The South Land Company, publishers; E. F. Russell, editor.

SMALL FRUIT RECORDER AND CABBAGE GARDENER, Palmyra, New York. Monthly, $1 per annum. A. M. Purdy, publisher and editor.

SORGO JOURNAL AND FARM MACHINIST, Cincinnati, Ohio. Quarterly, 50 cents per annum. Sorgo Journal Company, publishers; William Clough, editor.

SOUTHERN CULTIVATOR, Athens, Georgia. Monthly, $2 per annum. William & W. L. Jones, publishers and editors.

SOUTHERN FARMER, Memphis, Tennessee. Monthly, $2 per annum. M. W. Phillips & Co., publishers; Dr. M. W. Phillips, editor-in-chief.

SOUTHERN FARM AND HOME, Macon, Georgia. Monthly, $2 per annum. J. W. Burke & Co., publishers; William M. Browne, editor.

SOUTHERN FIELD AND FACTORY, Jackson, Mississippi. Monthly, $2 per annum. Wall & Rafter, publishers and editors.

SOUTHERN PLANTER AND FARMER, Richmond, Virginia. Monthly, $2 per annum. Ferguson & Rady, publishers; James T. Johnson and John M. Allan, managing editors.

SOUTHERN TIMES AND PLANTER, Sparta, Georgia. Weekly, $2 50 per annum. Harrison Brothers, publishers; B. H. Sansett, editor.

SWASEY'S SOUTHERN GARDENER, Tangipahoa, Louisiana. Monthly, $2 per annum. H. A. Swasey, publisher and editor.

TENNESSEE AGRICULTURIST, McMinnville, Tennessee. Weekly, $2 per annum. J. F. & D. F. Wallace, publishers.

TILTON'S JOURNAL OF HORTICULTURE, Boston, Massachusetts. Monthly, $1 50 per annum. J. E. Tilton & Co., publishers.

VERMONT FARMER, Newport, Vermont. Weekly, $1 per annum. Royal Cummings, proprietor; T. H. Hoskins, M. D., editor.

VERMONT RECORD AND FARMER, Brattleboro', Vermont. Weekly, $2 per annum. F. D. Cobleigh, publisher and editor.

WESTERN AGRICULTURIST, Quincy, Illinois. Monthly, 75 cents per annum. T. Butterworth, publisher.

WESTERN FARMER, Madison, Wisconsin. Weekly, $2 per annum. D. M. & G. E. Morrow, publishers and editors.

WESTERN POMOLOGIST, Des Moines, Iowa, and Leavenworth, Kansas. Monthly, $1 50 per annum. Mark Miller, Des Moines, publisher and editor.

WESTERN RURAL, Chicago, Illinois, and Detroit, Michigan. Weekly, $2 per annum. H. N. F. Lewis, publisher and editor; T. H. Glenn, Chicago, and Edward Mason, Detroit, Michigan, associate editors.

WESTERN RURALIST, Louisville, Kentucky. Monthly, $1 per annum. H. M. McCarty, publisher; Lawrence Young, editor.

WILLAMETTE FARMER, Salem, Oregon. Weekly, $2 50 per annum. A. L. Stinson, publisher; Simeon Francis, editor.

WORKING FARMER, New York City. Monthly, $1 50 per annum. William L. Allison, publisher and editor.

AGRICULTURAL RESOURCES OF WYOMING TERRITORY.

This Territory is situated between the forty-first and forty-fifth parallels of latitude, and the one hundred and fourth and one hundred and eleventh meridians of west longitude, and contains an area of 97,883 square miles.

Although lying immediately north of and contiguous to Colorado, and like it stretching across the great divide of the Rocky Mountains, in the character of its mountains and plains it is very different from that Territory.

The mountains of Colorado are grouped in a rather compact series of ranges on one side, and its plains lie in one body on the other, and are of a uniform character; while the mountains of Wyoming are scattered in isolated ranges and irregular groups, and the plains are detached areas, unsymmetrical in form and differing in character.

The divide between the waters of the Atlantic and Pacific starting from the northwest corner of North Park and running northwest by Bridger's Pass and Creston Station, crosses the comparatively low country to South Pass, whence it follows the Wind River Mountains to Mount Madison, where it leaves the Territory, passing out of its western border about 30′ south of its northwest corner. It divides the Territory into two unequal parts, the eastern part embracing about three-fourths of the entire area, the western part one-fourth. The greater portion of the eastern division is drained by the North Platte and the tributaries of the Yellowstone, while the western division is drained by Green River and its tributaries.

The arable tracts of this Territory, corresponding with its general features, are found in detached areas extremely varied in size and character, the extent of irrigable land being limited sometimes only by the supply of water, while in others, though the supply of water is ample, the extent of level land is very limited.

There is in Colorado no spot that can be called an absolute desert; on the other hand, there are few if any spots which wear heavy compact swards of green grass, the tuft and bunch being the characteristic growth of the plains; but in Wyoming not only the mean but the extremes are to be found.

The chief arable tracts, which as a matter of course depend upon the water supply and drainage, are to be found in the following areas, named as a general thing from the streams by which they are intersected: The Laramie Plains, the Sweetwater Section, and Eastern Plains, all drained

by the North Platte and its tributaries; the Wind River or Big Horn District; the Powder River country, and the Green River District. All of these divisions, except that drained by Green River, lie on the east side of the main divide of the Rocky Mountain range.

The district drained by the North Platte amounts to about 22,000 square miles, and embraces nearly one-fourth of the Territory, and, with the exception of a few small sections, it includes the most desirable portions, and the greater part of the arable land. This district is not only very irregular in its outline, but it bears the same varied and irregular character interiorly. The mighty convulsive force which heaved up these vast Rocky Mountain ranges seems here to have scattered the hills and mountains in wild confusion. In the eastern portion, stretching north and south, is a range of rough and lofty mountains which, at its northern extremity, is rent into fragments and scattered in decreasing peaks and ridges to the northwest. Along the southern border, turning in nearly every direction of the compass, are lofty ranges, whose summits wear crowns of perennial snow. Westward the mountain ranges, trending northwest, sink beneath the immense deposit of local drift which here covers the mighty chasm; but they show themselves farther north in the granite peaks which, like islands, shoot up from the Sweetwater Plains, and farther on they emerge in the Wind River range. Between these irregular surroundings lie the broad Laramie Plains, which might appropriately be called the Great Park of Wyoming.

The plains east of the Black Hills slope toward the Missouri River, while the area lying west of them, as shown by the course of streams and also by the barometer, slope north and east, sending the waters of its streams through the northeast angle of the district. The average level of this entire portion is higher than that of either of the others east of the divide, the western portion being on an average about 6,500 feet above the level of the sea. The difference of level between South Pass and the mouth of the Sweetwater is about 1,500 feet. The area east of the mountains varies from 4,400 to 6,000 feet above the level of the sea. On account of its altitude and the direction and force of its atmospheric currents, the temperature of this district is lower than that of the others east of the divide, within the bounds under consideration. As a general rule only such products as are adapted to a cold climate and short seasons can be raised to any advantage; yet it is important to know that a mining section can produce the principal cereals, as wheat, oats, and barley, and the more useful vegetables, in quantities sufficient to supply its own wants; and also to know something in regard to the locality and extent of its arable lands. A few acres of productive soil in the vicinity of a rich mine will often yield a greater profit than a large farm in Ohio or Illinois.

It is difficult to give any very reliable estimate of the land susceptible of cultivation in this district, as much of it is in small bodies of irregular shape. By proper efforts at least 2,500 square miles, or 1,600,000 acres, can be brought under cultivation. This may be thought an exaggerated estimate, when we take into consideration the large proportion of the area occupied by mountains, the barren tract south of the Sweetwater, and the deficiency in the supply of water on the plains east of the Black Hills; but when more effectual means of husbanding the water are adopted, as by tapping the streams near their exit from the mountains and keeping it above the surface by forming reservoirs, &c., the supply will be found greater than is at present supposed, and the estimate given, instead of being too large, may prove too small.

LARAMIE PLAINS.

This section is bounded on the east and northeast by the Black Hills, on the west by the West Rattlesnake Hills, and on the southwest by the Medicine Bow Mountains. It is somewhat quadrangular in shape, its average length from southeast to northwest being about ninety miles, and average width from northeast to southwest about seventy-five miles, containing (exclusive of the surrounding mountains) a surface area of about six thousand seven hundred and fifty square miles, or nearly 4,500,000 acres. It is drained chiefly by the Medicine Bow and Laramie Rivers and their tributaries, both affluents of the North Platte, which also traverses the extreme border. The Laramie, rising in the mountains at the southeast angle, flows along the eastern side to the northeast angle of the section, where it breaks through the Black Hills, and joins the North Platte in the eastern plains. The Medicine Bow, receiving affluents from each side, the principal ones coming from the south, flows through the western part of the section, and joins the North Platte on the western border. The North Platte makes its exit at the northwest angle of the plains, where, bursting through the mountains, it bends eastward. The surface varies considerably in character and elevation, some of it presenting beautiful meadow expanses, while other portions are rolling and hilly, and but sparsely covered with vegetation. The average elevation of these plains is about 6,500 feet above the level of the sea, but the height varies as much as 1,700 feet, counting from the water levels. As most of the streams afford an ample supply of water during the irrigating season, their volume and fall become important items in estimating the amount of land which may be brought under cultivation, and it is therefore a matter of regret that we have not more accurate information on these points in regard to the larger streams throughout this region.

The North Platte, at the railroad crossing, has an elevation of 6,477 feet, and at the mouth of the Sweetwater 6,000 feet, above the level of the sea, showing a fall in this distance of about 480 feet, or 7 feet to the mile. Medicine Bow River at Medicine Bow station has an elevation of 6,698 feet, and at its junction with the Platte about 6,300 feet, a difference of nearly 400 feet, or about 8 feet to the mile. Laramie River at Laramie City is 7,123 feet above the level of the sea, and at the point where it enters the Black Hills about 5,400 feet, a difference of over 1,700 feet, giving the very rapid fall of 18 feet to the mile. These figures develop the important fact that not only the bottoms, but also the upper levels, except where they are very high, can be irrigated, which fact must increase the estimate of the tillable lands of the section to an amount considerably beyond the area of the bottoms.

The southeast part, to which the name "Laramie Plains," or "Laramie Valley," is sometimes limited, is decidedly the best portion of the section, and contains much the largest proportion of arable land. From the head of this valley on the east to Rock Creek on the west it is about seventy miles long, with an average width of about twenty-five miles, giving an area of one thousand seven hundred and fifty square miles. Although it is interrupted at some points by ridges beyond the reach of irrigation, especially the divide between the Laramie and the Medicine Bow, it may be safely estimated that one-half of it can be irrigated and brought under cultivation. The greater portion of this beautiful valley is covered with a rich growth of grass, and presents the appearance of one broad meadow. Already numerous herds of cattle and horses can be seen roaming over this meadowy expanse, where they feed

the year round without other food and without protection save the care of the herder; nor are they confined to the broad, open bottoms, but graze far up the mountains on the south, cropping the nutritious grasses that line the little mountain coves and glens.

That portion of the valley lying west of Cooper's Lake presents a barren appearance as far as Rock Creek. This creek, although bordered by occasional bluffs, is margined along most of its course by fertile bottoms, of moderate width, and is tolerably well timbered with cottonwood groves along its upper portion. This valley and that of the North Platte north of the railroad will, with proper irrigation, afford a considerable extent of cultivable land. Judging from the northern extension of the Laramie Valley, its rapid fall, and the general features of the surrounding country, not only the bottoms but a large portion of the lower ridges and plateaus along this stream may be irrigated and rendered suitable for farming purposes. Along a part of its northern course the bordering lands are quite broken, and the belt of the arable land is small. The northwest angle of the section is also uneven, and affords but a small arable area.

The climate is somewhat severe, and the seasons short. The greatest drawback to successful cultivation does not appear to arise from these causes, however, but from the occasional untimely frosts and gusts of snow which nip the growing crops in the spring, or injure them when nearly matured. The cold nights, as is generally the case in these high regions, retard growth, especially of the cereals. Notwithstanding these drawbacks, repeated experiments made during the past four years have shown conclusively that useful crops can be raised. On the 3d of August, 1870, in a garden attached to the military hospital at Laramie City, where extensive experiments are being made in the cultivation of vegetables and cereals, everything indicated success. Peas, beets, winter-squashes, cabbages, beans, lettuce, onions, carrots, radishes, &c., were fine and thrifty. Barley and wheat both promised abundant crops, and potatoes were of the best quality. Tests made at Fort Saunders were attended with like encouraging results.

These experiments and others made along Laramie River, Rock Creek, and at other points, continued as they have been for several years, would seem to settle the question as to the practicability of farming on the Laramie Plains, as these points are the highest, and perhaps the coldest, on the plains. Although this section may not be an agricultural region in the broadest sense of the term, a knowledge of its capabilities for the growth of the hardier vegetables, and such cereals as wheat, oats, and barley, is a matter of importance in view of its situation, in the center of the mountains, on the great thoroughfare between the Atlantic and Pacific, with a broad barren plain to the west, and a mountain stretch to the east, and where a suitable halting place is desirable.

There is probably no finer grazing region in Wyoming than this. The southeastern part is literally carpeted with a compact growth of rich and nutritious grasses, kept constantly fresh by the water of the numerous mountain streams. The rain-fall is also greater than in any other part of the Territory, and it seems to be on the increase. Notwithstanding the elevation of these plains, the winters are comparatively mild and open, the fall of snow being light, and stock is wintered without shelter, and with very little feeding. Large flocks of sheep and cattle have passed the winter here with no other feed than the uncut grass of the valleys and plains. Hay in abundance and of the best quality can be obtained along the creek bottoms at nominal expense.

Timber, such as pine and fir, of excellent quality, may be found in the mountains along the southern border, and a vast quantity is annually cut and floated down the Little Laramie and other streams, for lumber, railroad-ties, &c. Some of the streams, especially along the southwest border, are margined by groves of cottonwood, which will furnish fuel and fencing for that locality.

THE SWEETWATER REGION.

This section of the Territory includes the valley and bordering plains through which the Sweetwater River passes, from the vicinity of South Pass to its junction with the North Platte. This stream rises a little northwest of the pass, and flows almost directly east about one hundred and thirty miles, connecting with the North Platte near the point where the latter leaves the Laramie Plains. For twenty-five or thirty miles east of the pass it flows through a rugged mountainous region, presenting no considerable areas that can be rendered cultivable. A short distance west of St. Mary's station it emerges from the narrow gorges, and enters a valley that extends, with occasional short interruptions, along the entire course of the river.

Beginning at the summit of South Pass, with an elevation of 7,490 feet, the descent is quite rapid to the point where the stream issues from the gorge, 6,650 feet above the level of the sea. This point, the highest of this section that can be counted arable, is 513 feet lower than Fort Saunders, and 473 feet below Laramie City, which would indicate, other things being equal, a milder climate.

At the three crossings the elevation is 6,135 feet, showing a fall between this point and the head of the valley of 515 feet, or about 12 feet to the mile. At Independence the elevation is just 6,000 feet, indicating a fall between this and the last-mentioned point of not more than 5 feet to the mile. Thence to the junction with the Platte the descent is probably 5 to 6 feet to the mile. The average elevation of the valley may therefore be estimated at 6,300 feet above the level of the sea.

For ten to twelve miles below the point where the stream leaves the mountains, there is a very pretty fertile valley, averaging about one mile in width, bordered on the right, and part of its length on the left, with high bluffs. The greater portion of this valley is covered with a luxuriant growth of grass, from which a supply is usually drawn for Fort Stambaugh, Atlantic City, and South Pass City.

Near the lower end of this opening, the left bank is flanked by a second level, or table, which might be reached by an irrigating ditch three or four miles long, and which, if watered, would furnish an amount of farming land equal to the entire bottom of the valley. Immediately below this point the hills close in upon the valley for a few miles, and then separate, leaving a triangular area containing thirty to forty square miles of quite level and tolerably fertile land, which can be easily irrigated.

From the north and northeast the hills slope down so gradually that a considerable area along their lower margins could be reached with water from the river, if the supply is sufficient for this and the bottoms. The stream here, on an average, is probably 30 feet wide and one foot deep, flowing quite rapidly, the fall being 10 to 12 feet to the mile. Here, as well as in the vicinity of St. Mary's station, small colonies would find very good locations, and, by combining and digging large primary ditches, their land could be irrigated at moderate expense.

The only difficulty aside from exposure to Indian depredations would be the scarcity of timber. Near St. Mary's this difficulty would be ex-

perienced. From this point the river bends round to the northeast, passing among the hills, and is flanked by alternate bottoms of small extent.

To the south of the river, forming a chord to its circular bend, runs a singular valley, ten to twelve miles wide, the general appearance of which is that of the bed of a stream which had been wide and shallow, although its surface looks exactly like the plateaus of this section. If the water of the river can be brought upon this level, as much land can be irrigated as the river can supply.

Where the road again strikes the river, going east, there is a considerable expanse of arable land ; and, although there is very little immediate bottom, the second level is quite broad and of moderate elevation, and might be irrigated by cutting a ditch a few miles in length. Below this, near the three crossings, the Granite Hills commence, and flank the valley as far as Independence Rock. Near the west end of this irregular range, for seven to eight miles, the river breaks through it, and is closely walled in by lofty bluffs, with here and there a level plat of a few hundred acres of fertile soil. There is an open plain running around the south side of these bluffs, several miles in width, which probably might be reached by a ditch twelve to fifteen miles in length.

After passing through the gorge here, the river enters a broad and beautiful valley, the upper portion of which is thickly covered with chenopodiaceous shrubs, the lower part bearing a tall thick growth of grass. From a hill at this point, looking eastward down the river, the valley can be seen for twenty or thirty miles, while southeast runs a higher valley, which is crossed and dotted with elevated plateaus, and flat-topped foot-hills. The mountain which, some distance east, runs along the south side a short distance from this point, terminates westward, while from the southeast, running northwest, comes another range which forms the southern boundary of the plain. At this place the soil is rich and light, and, with irrigation, would produce good crops. The immediate bottoms are of little value, being quite narrow, but the second level, 10 to 12 feet above the water, could be reached by a ditch a few miles long. It is probable that an area of eighty to one hundred square miles could be rendered suitable for farming purposes, and timber may be obtained from the neighboring hills.

In the vicinity of Hayden's Peaks the granite hills on one side and the bluffs on the other approach the margin of the river for a short distance, then recede in a circular sweep, and again come together a few miles beyond, forming a beautiful circular area, containing twenty to twenty-five square miles of rich and fertile bottom land which, slightly elevated above the stream, can be irrigated without difficulty. Passing under the overhanging cliff of yellow sandstone, through the gate-like opening of the little park first described, we enter upon a broad valley which continues without interruption to the "Devil's Gate," about four miles above Independence Rock.

The soil of this valley, though covered in part with "grease-wood" and sage, is very fertile, and will produce good crops. Muddy Creek, which comes in here from the south, has a considerable margin of level land, but affords hardly sufficient water for irrigating purposes. The breadth of land here is probably equal to the supply of water. Around Independence Rock, and for several miles above and below it, are fine irrigable bottoms. Between the river and Horse Creek there is a broad delta with an average elevation of twenty to thirty feet above the bed of the river, but less than that above the bed of the creek. Irrigating ditches could be made to reach this plateau, and also a considerable area

east of Horse Creek; but the ditch from the river would require two short aqueducts at the Devil's Gate. The soil of this plain is rich in the elements of fertility, though in some places strongly impregnated with alkali. At present it is covered with "grease-wood" and sage, except in the little areas which are frosted over with alkaline incrustations. Along the ridges and in the narrow valleys which lie around the head-waters of Horse Creek, and in the vicinity of Willow Springs, are some excellent grazing lands which have long been a favorite resort of the buffalo. The country along the North Platte, from the mouth of Sweetwater to Poison Spring Creek, is rough and mountainous, the river for the most of this distance running through deep, and often perpendicular, gorges.

The length of the Sweetwater Valley, from its commencement above St. Mary's station to the Platte, is about ninety miles, and the average width of the land which can be irrigated and rendered suitable for cultivation may safely be estimated at five or six miles. This would give an area of about five hundred square miles, or 320,000 acres of tillable land. Judging from the altitude, surroundings, and slight information received on this point, there are good reasons for believing that the climate will prove more favorable to agriculture than that of the Laramie Plains, to which it is much inferior as a grazing region, though the river bottoms and some of the mountain slopes afford very good grass on which numerous herds of antelopes at present graze. Timber is scarce from the vicinity of St. Mary's station to the Platte. The bordering hills and mountains bear a few pines, and the bottoms a few small willows; but these would hardly furnish a supply to even a moderate population. A supply might be obtained from the mountains at the east or the west end of the valley.

THE EASTERN PLAINS.

Under this name may be included all that part of the Territory lying east of the Black Hills. It includes, in addition to the open plains, the valley of the North Platte from the Red Buttes to the eastern boundary of the Territory, and the valleys of the numerous tributaries which enter into it between these points; also the valleys of Crow Creek, Larren's Fork, and Lodge Pole Creek. This section contains about nine thousand square miles, of which perhaps one-sixth, or nearly one million of acres, can ultimately be irrigated and rendered suitable for farming purposes. This estimate of the arable portion is much larger than has generally been made, but from recent information furnished this Department is not considered exaggerated. A more careful examination of the volume of water sent down by the North Platte and its tributaries, and of the rain-fall during the growing season, may somewhat modify this estimate, but will not reduce it to any considerable extent. Some idea of the general level and topography of this area can be obtained from the following list of elevations recently taken: Beginning at Red Buttes and following the Platte, the elevations above the level of the sea are as follows—Red Buttes, 5,523 feet; five miles below the Old Bridge, 5,252 feet; on the river bottom near Fort Fetterman, about 4,970 feet; Fort Laramie, about 4,500 feet; mouth of Horse Creek, 4,395 feet. This shows that the entire fall from Red Buttes to Horse Creek is 1,133 feet, or about 7 feet to the mile. From Red Buttes to the Bridge, 18 feet to the mile, and from Red Buttes to Fort Fetterman, 9 feet. The elevation of the Laramie bottom at the mouth of Chugwater is about 4,500 feet; the Chugwater Valley where the stage road to Fort Laramie strikes it, 5,460 feet; and that of Cheyenne, 6,040 feet. These figures develop a

fact of the utmost importance in estimating the agricultural resources of this part of the Territory. A fall of over 500 feet in sixty miles, with the volume of water found in this part of the river during the irrigating season, will afford the means of redeeming a very large area of land.

Poison Spring Creek is a small stream coming down from the northwest and entering the North Platte at Red Buttes. It passes through a very pretty valley which averages about one mile wide, and is flanked on the west by a broad plain which gradually ascends as it recedes. On the east, parallel to it, runs a sharp ridge of perpendicular upheaved strata. It has been stated that the waters of this stream are poisonous, but this is a mistake, as men and animals have been known to drink of it without injury; besides, several species of plants grow in it luxuriantly, one of which has been brought to this Department in some of the water of the stream, and when submitted to the microscope was found to contain minute living organisms. The idea of its being poisonous probably arose from the presence of alkaline matter. The amount of water in this creek is presumed to be sufficient to irrigate the narrow valley, which is covered with a rank growth of grass.

Near the Red Buttes, (or Red Bluffs,) in the bend of the North Platte, is a beautiful bottom of twelve to fifteen hundred acres of very rich soil. South of the river it is covered with a thick grove of willow, cottonwood, &c., but on the north side the timber has been destroyed by emigrants and others who have camped at this point.

Immediately below this place the river enters a gorge, and breaks through a spur of the mountain for nine or ten miles, before it enters upon the plains near Old Fort Casper. If canals can be carried through this gorge, there will be no serious difficulty in taking the water onto the elevated table lands which set in immediately below it; and, from information received, this appears to be possible, as the sides descend abruptly only at one or two points. Tunneling might be necessary for a short distance on the north side, but there will be no other serious obstacle. This will not be necessary at any point on the south side. The North Platte, just below the remains of the old bridge, when examined at the season of the year when it is low, was about 160 feet wide, with an average depth of two feet, and a current of over three miles per hour. This would give a discharge of more than 5,000,000 cubic feet per hour. As the volume of water at this season is not more than two-thirds as great as in the spring and early summer, the discharge, during the irrigating season, may be estimated at 7,500,000 cubic feet per hour. If this estimate is even approximately correct, (strict accuracy is not claimed,) it is probable that one thousand square miles of land may be irrigated from this river alone.

The following description of some points along this stream will give a general idea of its valley east of the mountains. In the neighborhood of the bridge, on the south side of the river, there is a broad level bottom, four to five miles wide, mostly covered with a rank growth of grass, mixed with tall weeds, showing the soil to be quite fertile, and that it contains a fair proportion of vegetable mold.

A short distance below Casper a second level sets in, raised but a few feet above the first. This is one entire sage plain, and spreads out to some eight or nine miles in width, and is composed of a soil somewhat inferior to that of the bottom. Before reaching Muddy Creek, the low, rounded hills approach the river for a few miles, limiting the bottom to a mere strip. At Muddy Creek it again expands to six or eight miles, being covered in part by a very thick growth of grease-wood. The lit-

the creek, though very narrow, being confined to a little ditch-like channel cut through the compact soil, is deep in proportion to its width, and would furnish sufficient water to irrigate a considerable area. The soil is very fine-grained, with a marly appearance.

On the north side of the river, for most of this distance the elevated plateau approaches quite close to the stream, and, descending suddenly, forms a line of bluffs 100 to 150 feet high. For some distance above Fort Fetterman there is a very pretty and quite broad valley, partly bottom and partly a low second level, which can be irrigated from the river at a very moderate expense, and would make good farms. There are also some very fine grazing fields here.

West of the Fort Deer and Box Elder Creeks flow into the Platte from the south. Taking their rise in the Black Hills, they run constantly, and afford sufficient water to irrigate the narrow valleys through which they pass. Here, also, are some fields of excellent pasturage, the principal supply of hay for the fort being cut from the valley of Deer Creek. La Perle Creek, which joins the Platte near the fort, is bordered chiefly by boulder hills, and presents but little attraction for the agriculturist. Between Fort Fetterman and Laramie River a number of streams, rising in the Black Hills, run east and empty into the Platte, the most important of which are the La Bonté, Elkhorn, Horseshoe, and Bitter Cottonwood. The valley of the La Bonté, which is two to three miles in width, is very fertile, the bottoms easily irrigated, and the supply of timber ample. Not only are the hills clothed with pines, but the valley at points is covered with tolerably heavy groves of cottonwood, willow, &c. Here is a very good point for a small colony. Horseshoe and Elkhorn Creeks traverse small valleys, but as the supply of water is not constant they cannot be depended upon for irrigating purposes unless the water is brought down in ditches from the point where they leave the mountain.

The immediate bottom of the Bitter Cottonwood is rather narrow, but is flanked by a low second level of considerable breadth, so that the amount of land within reach of irrigation is fully equal to the supply of water from the creek.

The valleys of the Laramie and Chugwater present the most desirable points for agricultural purposes along the east flank of the Black Hills. The short valley of the Laramie River, between the mountains and the Platte, will furnish an arable area of perhaps seventy-five to eighty square miles. With an elevation of about 1,500 feet less than Cheyenne, and 2,600 feet lower than Laramie City, and shielded from the winds by its elevated surroundings, it has a climate several degrees warmer than most of the section; and, with a rich soil and ample supply of timber, it is destined to be soon filled up when the tide of emigration turns toward this section of the Territory.

The Chugwater runs northeast for thirty-five or forty miles along the base of the Black Hills, watering a beautiful valley which averages about two miles in width. This valley, for the greater part of its length, is bordered by high, rocky walls or steep bluffs; the bottoms are fertile, and, being quite low and level, can be easily irrigated. The supply of water is sufficient during the season when needed, but it sinks at some points in the latter part of the summer and autumn.

There is a considerable amount of valley land and level bottoms along Horse Creek and its affluents, but the supply of water is limited, and therefore it is not probable that any great area will ever be rendered available for tillage. It is possible, however, that by making reservoirs along the little ravines, which at certain seasons of the year are filled

with water, a sufficient quantity might be collected to irrigate a large number of acres, thus materially increasing the agricultural resources of this part of the Territory.

Lodge Pole Creek is an isolated stream, rising near Cheyenne Pass, in the Black Hills, and flowing, with a moderate eastward descent, through a narrow valley, bordered on each side by broad, rounded ridges. The amount of bottom-land is quite limited, but is all the stream will irrigate, as the supply of water does not appear to be very constant. A canal, drawing off the water near the mountains, would probably furnish a larger and more uniform volume.

Crow Creek rises in the Black Hills, west of Cheyenne, and, running east a short distance beyond the city, turns south and passes into Colorado. Although this stream is small, its proximity to the city of Cheyenne makes it important, and measures have been inaugurated to preserve and utilize all the water it can supply. With sufficient water, the entire plains around the city could be irrigated, and the land made to produce useful crops. There are some reasons for believing that the rain-fall is increasing in this vicinity.

The temperature of this section varies considerably in its different parts, corresponding somewhat to the elevation and freedom from the prevailing winds. All the agricultural products which can be grown in other parts of the Territory can be raised here, such as wheat, oats, barley, rye, and hardy vegetables; and it is probable that in the valley of the Lower Laramie, and at some points along the Platte, Indian corn and hardy fruits may also be raised.

Fine grazing-fields are to be found throughout this section in the valleys and along the slopes of the mountains, and, even where there are no running streams, wells may be dug and water found at moderate depths, which can be raised by wind-mills in sufficient quantity to supply stock, and possibly to assist in irrigation. Timber can be obtained in abundance from the Black Hills and along the streams near their base.

Successful experiments have been made in farming and gardening around Cheyenne and at Fort Fetterman, which are, perhaps, the coldest portions of the section.

THE WIND RIVER DISTRICT.

Very little information has been received in relation to this district, yet the following facts are an important addition to our knowledge of this region:

The district is drained by the Wind or Big Horn* River and its tributaries, and is situated between the Wind River Mountains on the west, and the Big Horn Mountains on the east. Its length from Little Popoagie to the Big Horn Cañon is about one hundred and seventy miles, with an average width of about one hundred miles.

Wind River rises in Wind River Mountains, and, flowing southeast for about sixty miles, bends abruptly north, which is its general course thence to its exit from the Territory. The valley is estimated to be two hundred miles in length, and two to fifteen miles in width; but it is very frequently interrupted by irregular ranges of hills and spurs of the mountains, and at one point a considerable range sweeps across from east to west. The following tributaries flow into the river from the north and west, viz: The North Fork, Owl Creek, Gray Bull, and Stinking Water Creeks. On the south and west sides are the following affluents: South Fork, Buffalo Bull Creek, Big Popoagie River, Beaver Creek, and No-

* This stream is called Wind River until it passes through the first range of mountains, north of which it receives the name of Big Horn River.

Wood River. The valleys of these streams furnish arable land which is quite fertile, and can be easily irrigated, and all of them except No-Wood River are skirted by groves of cotton-wood and willow.

Some experiments in farming have been made in the south end of this district, which have proved more successful than could have been anticipated from the latitude, surroundings, and knowledge of the regions south of it. Wheat, oats, barley, and rye can be raised with ease, but the seasons are not quite mild enough for corn. Potatoes and cabbages grow finely and of good size; and even beans grow well, producing fine, large pods, indicating a comparatively mild climate. Although the altitude of this section is unknown, there are some reasons for believing that it is less than that of the Sweetwater Valley. It is probable that it will not average more than 5,000 feet above the level of the sea. Some good grazing fields are found within its bounds, yet it does not appear to equal as a pasturing region the Laramie Plains and Platte district.

GREEN RIVER DISTRICT.

This part of Wyoming lies west of the main divide of the great Rocky Mountain range, its waters passing through the Colorado of the West, to the Pacific Ocean. It is a part of that vast inter-alpine valley lying between the Rocky Mountains and the Sierra Nevada ranges, which reaches north to the plains of the Columbia, and south to the broad plateaus of Arizona and Mexico.

That portion of the area drained by Green River and its tributaries, which lies within Wyoming, amounts to fifteen or sixteen thousand square miles. Its southeastern part consists principally of broad, barren, sage plains, with little water, and is of but little value. The southern part is composed chiefly of boulder ridges and plateaus, with washed and bluffy escarpments. This portion is partially supplied with streams bordered by narrow arable strips of a very barren appearance, but quite productive when irrigated. The southwest corner is broken and mountainous, and contains very little land that can be cultivated, but affords some fine grazing fields. The northern, triangular portion, lying between the Wind River and Wahsatch Mountains, contains the greater part of the arable land of the district. It is composed of three distinct parts, as follows: The Green River Valley, the Big Sandy Valley, and the broad, elevated plain lying between them.

Green River, rising near Fremont's Peak, runs south about one hundred and twenty miles to the forty-second parallel, where it turns southeast, and is joined by the Big Sandy, where it crosses the one hundred and tenth meridian. It continues the same course, after receiving the waters of the Big Sandy, to the crossing of the Union Pacific Railroad, where it again turns south and passes out of the Territory. Between its source and the forty-second parallel it receives the following tributaries, which flow down from the Wahsatch Mountains on the west: Lead Horse, Marshy, White Clay, Butternut, Piney, LaBarge, Fontenelle, and Slate Creeks. Although the immediate bottoms which flank these streams are generally narrow, the upper or second level is easily reached, and a large amount may be irrigated from these constant streams. Green River, just above the mouth of Big Sandy, even as late as the 1st of September, where running rapidly, was found to be about 120 feet wide and 15 inches deep, indicating a discharge of about 2,500,000 cubic feet per hour. This amount of water, with a fall of 8 or 10 feet per mile, and an almost illimitable area of level land each side, shows that a large extent of country may be rendered suitable for farm-

ing. It is safe to estimate the available land in this part of the district at 500,000 acres.

The broad tract that spreads out between Green and Big Sandy Rivers is level and sandy, presenting a barren and desolate appearance, on which account it is sometimes called The Colorado Desert. It is covered with a low growth of *Artemisia;* but, notwithstanding this, the soil possesses the elements of fertility and needs only the addition of water to make it productive.

The Big Sandy rises in the Wind River range a few miles northwest of South Pass, and runs south until it is joined by the Little Sandy, when, bending southwest, it continues this course until it joins Green River. For most of its course it runs through a very narrow valley presenting but little bottom land, averaging perhaps half a mile in width; but, as its fall is rapid, being 18 to 30 feet to the mile, its waters can easily be carried to the highest bordering plateaus, which seldom rise over 100 feet.

The elevation of this triangular section varies from 5,500 to 6,500 feet above the level of the sea. Its climate corresponds very nearly with that of the Sweetwater Valley, and, as its soil is very similar, its productions will be about the same as in that valley.

The north part of Green River Valley may have some good grazing lands, but neither the lower part of this valley nor that of the Sandy afford any extensive areas suitable for pasturage. As a general thing, this entire area is destitute of timber, none, save a few cottonwood groves on the lower part of Green River, being found nearer than the mountains. Black's Fork is bordered by a bottom of moderate width, which will afford space for a number of farms and a fine grazing field. Around Fort Bridger, on the headwaters of Black's Fork and its tributaries, Smith's Fork and Cottonwood Creek, and on Henry's Fork are some fine farming lands. On Smith's Fork several farms are already in cultivation, producing fine crops of wheat, oats, barley, potatoes, &c. The altitude here is about 7,000 feet above the level of the sea.

It is probable that this entire district, if irrigated to the full extent of the water supply, would furnish 600,000 to 700,000 acres of tillable land.

THE GREAT SALT LAKE BASIN.

This basin is a vast elliptical depression, in the great interalpine trough of North America, lying partly in Utah and partly in Nevada. It extends north and south about three hundred and fifty miles, varying in width from fifty to three hundred miles, averaging about one hundred and eighty or ninety. As but little of it has been surveyed and much of it but partially explored, it is difficult to give a reliable estimate of the proportion of tillable lands.

An irregular range of hills or mountains, starting from the southwest corner of Salt Lake, and running south, a little west of the one hundred and thirteenth meridian, extends to the thirty-eighth parallel. Here it bends to the southeast, and forms an imperfect junction with the southern extremity of the Wahsatch Mountains. The basin is divided by this range into two unequal parts; that on the east being much smaller than the western portion. An examination of the latter develops the fact that the lake formerly extended over a much larger area in this direction than at present, as it consists chiefly of broad, flat, sandy

plains, often destitute of vegetation, and in many places covered with saline incrustations. The arable lands of this western section are limited to the extreme southeast border. As the entire basin consists of smaller basins with distinct water systems, a description of it will be better understood by basins and valleys than by arbitrary sections. Omitting the broad plains of the northwest, the following are the more important of the minor basins: Salt Lake Basin proper, Rush Valley, Sevier River Basin, and Beaver River Basin.

SALT LAKE BASIN PROPER.

The territory immediately around the lake, and that drained by the numerous streams flowing into it, are embraced in this basin. Of these streams the principal ones are Bear, Weber, and Jordan Rivers, the last including as its tributaries the streams that discharge their waters into Utah Lake.

This basin is nearly two hundred miles in length, and contains one-fourth of the entire district, and within its boundaries are to be found the choice lands and chief population of Utah. The division is best described by taking the valleys in order, beginning at the north end of the lake, moving east, and then south.

Hansee Spring Valley and Blue Spring Valley lie north of the promontory. Their southern portions present a barren appearance, and are but thinly covered with vegetation; the soil is impregnated with salt or alkali. The first of these valleys is not supplied with streams sufficient to furnish water for irrigating purposes, and the principal stream in the other is strongly impregnated with saline matter. It is probable that some better portions and some small areas susceptible of cultivation may be found toward the north, and grass may also be found near the mountains.

The Malade Valley, which extends north into Idaho, is drained by the Malade River. It is a tolerably fertile section, and, including the shore of Bear River Bay, is about forty miles in length, with an average width of five miles. Within its boundaries are about one hundred and fifty square miles of irrigable land, with some fine grazing fields in the northern part. Although the Malade River is narrow, it has a sufficient volume of water to irrigate all the level land of the valley as far south as the "gate," or cañon, through which Bear River emerges.

The south end of the valley can be irrigated from this point by the latter stream, and it is understood that a project has recently been inaugurated to accomplish this. There are several thousand acres in the vicinity of Corinne that can be brought under cultivation, and would undoubtedly prove quite profitable, though a great portion of the land near the bay is too much impregnated with saline matter for cultivation.

Next, on the east, is Cache Valley, which extends north and south from the divide between Muddy and Box Elder into the southern border of Idaho, and is an expansion of the otherwise narrow valley of Bear River. It extends from Paradise to the mountains above Franklin, a distance of about fifty miles, and varies in width from six to sixteen miles, with an average of twelve. About one-half of its area, or three hundred square miles, can be irrigated and rendered suitable for cultivation. The benches and uplands as well as the bottoms, between Paradise and Franklin, may be irrigated by digging ditches a few miles in length; for, in addition to the river, a number of little streams flow into the valley from the Wahsatch Mountains, as follows: Muddy, Blacksmith's Fork, High Fork, Gros Bois Creek, and Logan's Fork, on the east, and Rush Creek from the west.

This is probably the finest grazing section in the entire basin, and being situated near the junction of three railroads, must become a favorite pasture ground for stock-raisers and stock-traders. Occasionally, feeding may be required for a short period during the winter months, which seldom continues over three or four weeks. This is also one of the best wheat-growing valleys in the district, being second only to the San Pete. It is not so well adapted to the culture of fruit or corn as the sections farther south, both it and the Malade being colder than the valley of the Jordan; yet apples and some of the hardier fruits can be raised. A considerable population has been attracted hither by the delightful features and situation of this valley, and already between thirty and thirty-five thousand acres have been irrigated.

Box Elder and the other little streams that connect with it are bordered by some excellent lands, which can be easily irrigated, and upon which a settlement has been made and a portion brought under cultivation.

Bear River rises in the Uintah Mountains, near the southwest corner of Wyoming, and running north within Utah Territory, but very near the eastern boundary, passes up into Idaho forty or fifty miles, where, bending suddenly southwest, it enters the Cache Valley. Most of the distance, from where the Union Pacific Railroad strikes it to its northern bend, it is flanked by a narrow strip of bottom land, which expands occasionally to four or five miles in width, as in the vicinity of Medicine Butte, and near the point where it crosses the boundary line; but for the whole length the average width is perhaps not more than one mile. The chief value of this belt will be its use as a grazing region when the broader valleys have been taken up, its elevations and mountainous surroundings making it too cold for any but hardy cereals and vegetables. The river has an average fall of about 12 feet to the mile, sufficient to carry it upon any of the bordering table lands not over 100 or 150 feet high. Around Bear River Lake there is a strip of arable land and some grassy meadows.

There is a little park in the Wahsatch Mountains, about fifteen miles long and seven miles wide, called Ogden's Hole, which is drained by Ogden Creek. This charming little valley is surrounded on all sides by lofty mountains, from which flow little streams of crystal water, sufficient to irrigate nearly the entire area. A thick growth of nutritious grass, affording excellent grazing, covers the greater part. The climate and products are similar to those of Bear River Valley.

Weber River, along which the railroad runs for some distance, from the place where it emerges from the cañon to where it enters Salt Lake Valley proper, passes through a very pretty and, for the most part, fertile section, which is rapidly filling up with villages and settlements. Its low bottoms are easily irrigated and quite fertile, the greater portion being already under cultivation or occupied. At some points the boulder deposits interfere with its cultivation, but these areas are limited.

The valley contains about one hundred square miles, or sixty-four thousand acres of arable land, including the little spots on Echo Creek. Although the climate is somewhat colder than that of Salt Lake Valley, apples and even other fruits can be raised without difficulty.

The "Salt Lake Valley," which name is limited to the strip of level land lying along the eastern shore between the lake and the Wahsatch Mountains, in a direct line from Salt Lake City to Willard City, is about fifty miles long, varying in width from two to fifteen miles, and averaging about ten. About three-fifths, or three hundred square miles, of this area

are susceptible of cultivation, though with the present system of irrigation it would be difficult, if not impossible, to obtain sufficient water to irrigate this extent; but, by making reservoirs, and bringing upon it all the water that is within reach from the streams north and south, this estimate will not be too large. In this way part of the higher lands south of Weber River may be rendered fit for culture. The farms already under cultivation show that the soil is rich and productive, though in many places covered with artemisia, and more or less impregnated with saline matter. The northern and southern portions contain the principal settlements, as there the land is lower and more easily irrigated.

The valley of the Jordan extends almost directly north and south from Utah Lake to Great Salt Lake. The distance from the lower end of the cañon, near Utah Lake, to its northern boundary, where it expands and forms a part of what has been included in the Salt Lake Valley is about twenty-six miles, with an average of fully fifteen miles. This gives nearly four hundred square miles as its area, the estimate being confined to the valley plains, four-fifths of which can be irrigated. Lieutenant Beckwith gives thirty miles as its length and twenty as its width; but he counts from Utah Lake, and includes the mountain slopes. The direct length, by Government survey, from the base line which runs near the north side of the city to the southern line of Salt Lake County, which crosses near the cañon, is just twenty-four miles. This beautiful valley has a cultivable area of three hundred square miles.

Most of the tributaries of the Jordan enter it from the east side, and the only ones of any importance south of the creek that waters the city are Mill, Big Cottonwood, Little Cottonwood, and Willow Creeks. Ditches have been made recently along the eastern border of the valley, drawing the water from Cottonwood Creeks, near the mountain, and carrying it on the somewhat elevated plateau that occupies a considerable area on this side of the river.

This effort has clearly demonstrated the possibility and practicability of irrigating nearly every acre on the east side of the river, north of Willow Creek. Although but little of this plateau or higher level has been tilled, the primary canals and a number of the smaller ditches are already made, and early in the fall of 1870 were filled with running water. In the vicinity of Willow Creek there is a small area of slightly rolling land which probably cannot be irrigated, not because of its elevation, but because this stream does not furnish sufficient water. If reservoirs can be established along the base of the mountain there will be no necessity for even this portion remaining idle.

An extensive canal is now in course of construction for the purpose of irrigating the great body of land on the west side of the river. Starting within the cañon, and but a few feet below the level of Utah Lake, the water is to be conducted from the Jordan along the base of the Oquirrh Mountains, at as high a level as possible. This will furnish sufficient water to irrigate the larger portion of the lands on that side; but the fall is not sufficient to reach the higher margins of the sloping plain. When these works are completed and the fresh water from Utah Lake has permeated the soil for a few years, this valley, seen from the neighboring heights, will appear as one vast garden.

The soil of the flat lands around the city, when first settled by the Mormons, was so thoroughly saturated with saline matter that for several years there were considerable areas upon which no crops could be made to grow. At length experience taught them that by sowing herds-grass, and irrigating freely, it could be rendered suitable for the culture of other crops. Mr. R. L. Campbell, of the Agricultural and Manufac-

turing Society, states that lands which were formerly rejected on this account are now being rapidly appropriated for farms. We cannot give the exact number of acres that have been irrigated in this valley, as the latest returns are only up to 1867, but there are probably twenty thousand to twenty-five thousand acres, exclusive of the area that may be reached by the Jordan canal.

The Tooele Valley is about sixteen miles long and ten miles wide, and is probably the most fertile spot in the Territory. The small streams that run through it afford sufficient water to irrigate the greater part of its area, and therefore its agricultural lands may be estimated at one hundred and sixty square miles, the full extent of the valley surface. The soil appears to be peculiarly adapted to the growth of the cereals, it being not uncommon to cut sixty to seventy bushels of oats from an acre, and last year one field of ninety acres averaged sixty bushels to the acre. It is already pretty well occupied, having one woolen manufactory and five grist-mills, and fourteen to fifteen thousand acres irrigated.

Lone Rock, or Spring Valley, which lies at the southwest corner of Salt Lake, does not appear to have attracted much attention, and is not so well known as others in the region, probably on account of its locality. It is about twenty miles long and eight to ten miles wide, and, with the exception of its northern end, is well covered with grass, affording excellent grazing fields. A small area can be irrigated and brought under cultivation around the southwest margin, but the central portion is watered principally by springs, which render the surface marshy in places. Ditching through the marshy parts would doubtless draw off sufficient water to leave the ground firm and suitable for grazing, and perhaps for culture. The northern portion, as it approaches the lake assumes a more barren appearance, and in some places is frosted over with saline incrustations, while the southern end is much like Tintic Valley.

UTAH LAKE VALLEY.

Passing southward over the ridge at the upper end of the Jordan Valley, we enter the Utah Lake Basin. The principal portion of the arable lands of this basin, or valley, stretch along the eastern shore of the lake, and back from its margin to the foot of the mountains, which here descend abruptly to the plains. The length of this semicircular belt, from the exit of the Jordan to Santaguin, is about fifty miles, with an average width of six miles. This entire area of three hundred square miles can be irrigated, the numerous streams that rush down from the mountain cañons affording sufficient water not only for the lower bottoms, but also for the broad, elevated plateau that extends from Battle Creek to Provo River. This plateau was supposed to be beyond the reach of any of these streams, and was considered uncultivable; but a little energy has recently shown to the contrary. A canal, commencing some distance up Provo Cañon, has been constructed along the steep mountain slopes, and now brings the water from Provo River to the highest point of this elevated plain. In the fall of 1870 the secondary ditches were filled with water, spreading here and there large pools over the dry plains. Although but one or two fields were in cultivation at that time, farms were being marked off and preparations made for cultivating the soil. It is probable that this rejected plat will prove the best wheat-growing tract in the valley of Utah Lake, and that ere long it will be dotted over with farm-houses and fields of golden grain.

The following is a list of the streams that run down from the mountain and cross this shore strip, given in the order in which they come,

beginning at the north end of the lake: Dry Creek, American Fork, Battle Creek, Provo River, Spring Creek, Hobble Creek, Spanish Fork, and Petenête Creek. These streams are bordered by no valleys or bottoms within the mountains; for, with the exception of Provo River, they do not reach beyond the first range, but, rushing down its slope, enter suddenly upon the plain and sweep across it to the lake.

The soil is generally very fertile, that along the margin of the lake containing a large proportion of vegetable mold; that near the mountain and on the plateau is intermingled with small boulders, but not to such a degree as to injure it. From Battle Creek north, and from Provo River south, it is pretty well settled, and most of the choice bottom lands are occupied; but there is a broad strip along the lake margin not cultivated, but used as grazing ground for the cattle of the citizens of the villages located on the creeks. Including Tintic and Cedar Valleys, there are at least twenty thousand acres of irrigated land in Utah County; and, if the canal cut from the Provo is of sufficient capacity to water the whole surface of the plateau, twenty thousand acres more may be added. Tintic Valley, which lies southwest of Utah Lake, is a a narrow, bay-like indentation in the range of hills or low mountains that sweep around the west side of the basin. It is about twenty-five miles long, north and south, and four or five miles wide, and is watered principally by springs. As there are very few streams from which water can be drawn to irrigate the soil, a small portion only of the land can be brought under culture; but as a grazing section it probably stands next to the Cache Valley. The grass grows luxuriantly, and is kept fresh and nutritious by the water from the numerous springs; and the comparatively mild climate precludes the necessity of winter feeding or shelter, as is sometimes required in the northern part of the Territory.

Cedar Valley lies west of the lake, behind the range of hills that here rises up near the shore, and is about thirty miles long from north to south, and averages ten miles in width, and contains, perhaps, one hundred and fifty square miles of cultivable land. It is watered by two small streams that run in from the west and northwest, which are sufficient to irrigate the northern and western portions, especially around Crittenden and Cedar City. The soil is good and productive. The valley is partially settled, and there are already two saw-mills and one flouring-mill in operation.

Moving southward from Santaguin, we enter the Juab Valley, which extends from this point to the divide between Utah and Sevier Basins, a short distance below Nephi. It is about fifty miles long and six miles wide, and contains one hundred square miles of irrigable land, principally along Salt and Clover Creeks. The most of the remainder is well grassed over and affords good pasture land for sheep and cattle.

Everything that can be raised in the Middle States can be raised in Salt Lake, Jordan, and Utah Valleys, and these sections bear about the same relations to the colder elevated mountain districts and southern borders of the Territory that the Middle States do to New England and Georgia.

This basin, with all its drawbacks, may be truly called an oasis on the great continental highway of trade and travel. Possessing the advantage of situation, surrounded by mountains rich in the precious metals, and having a healthy climate, it must, in the course of a few years, become densely populated.

The general level of the Salt Lake Valley is about 4,300 feet above the sea level, and that of Utah Lake Valley between 4,550 and 4,600 feet.

In the mountains east of the Jordan are three little parks, or elevated valleys—Parley's Park, Kansas Valley, and Round Prairie—which belong to the basins under consideration. Parley's Park is elevated about 2,000 feet above Salt Lake, and is five to six miles long and two to three miles wide. It is watered by Cañon Creek, and could be easily irrigated; but, on account of its elevated situation and mountainous surroundings, it is too cold for any except the hardier productions. The recent discovery of mines in the mountains in its vicinity may bring it into notice.

Kansas Valley, which is similar to Parley's Park, is about ten miles long and two to four miles wide, and can also be irrigated. Both afford good grazing fields; but, on account of the difficulty in reaching them, and their small size, will not be of much value in an agricultural point of view.

RUSH VALLEY.

This valley appears to be a small, isolated basin, having a distinct water system of its own, Rush Lake, lying in the north part, being the reservoir. It is about forty or fifty miles in length from north to south, and averages fifteen miles in width, a large portion of which can be irrigated, estimated at three hundred square miles. Clover Creek, which flows into Rush Lake, is a stream of considerable size, and affords sufficient water not only to irrigate a large extent of land, but also power to drive machinery. The lake is about eight miles long and three to four miles wide. Some mines recently discovered at the north end of this valley, if they prove productive, will furnish a market for farm products. Stockton, at the north end of the lake, is a village of considerable size. The farms in this vicinity are irrigated from a stream running from the mountains near by, and emptying into the lake.

SEVIER RIVER BASIN.

This comprises the country drained by the Sevier River and its tributaries. The river, rising in the southwestern part of the Territory, runs a little east of north between two ranges of the Wahsatch Mountains for one hundred and fifty to one hundred and sixty miles, where it breaks through the western ridge and runs southwest forty to fifty miles, and empties into Sevier Lake. Its principal tributaries are the San Pete River and Meadow Creek. The former, rising a little south of Mount Nebo, runs southwest through the San Pete Valley and joins the Sevier River near the crossing of the one hundred and twelfth meridian and thirty-ninth parallel. The latter commences in the divide south of the Rush Valley and traverses the plains west of the mountains, uniting with the Sevier at the bend. From information furnished the Department, it appears that the south side, at least, of this lake has a well-defined shore, and that the river, for some distance above its entrance into the lake, is occasionally flanked by bottoms which are susceptible of cultivation, and that a number of spots west of this, formerly supposed to be utterly sterile, may be rendered productive. The irregular form of this basin and the uncertainty in regard to its western rim make it impossible to give a reliable estimate of its area.

The San Pete Valley, which is watered by the San Pete River and numerous small tributaries, counting from Fountain Green to Gunnison is forty-four miles long and averages fully five miles in width. At least two hundred square miles, or nearly the entire surface of this beautiful and fertile valley, can be irrigated. The returns of the Agricultural and Manufacturing Society for 1866–'67 give nearly twenty thousand acres as the number then under irrigation, which has been in-

creased fully 25 per cent. during the past three years. This valley, as a wheat-growing section, stands among the first in the Territory, its soil being peculiarly adapted to the production of this cereal. It is also the best potato region in the Territory. Its altitude averages about 5,000 feet above the level of the sea, the elevation at the mouth of the San Pete River being 4,960 feet.

The Sevier River Valley is a long, narrow belt lying between the wings of the Wahsatch range, and extending southwest and northeast one hundred and ten to one hundred and fifteen miles. For fifty to sixty miles above Gunnison it averages six to seven miles in width, but is wholly without timber, and has a barren appearance, even the artemisia being scattered and stunted. The river channel is generally a deep ditch-like cleft in the soil, six to eight feet below the surface of the plain, its immediate bottoms being very narrow. With the considerable fall in the stream a great portion of the valley can be irrigated, and, notwithstanding the present barren appearance, after a few years' irrigation, may become quite fertile and produce good crops of wheat, oats, potatoes, &c. There are some settlements in the north part of the valley, and a few thousand acres under cultivation in Sevier and Pinto Counties, which embrace this valley. The elevation ranges from 4,800 to 5,500 feet above the level of the sea, and the volume of water in the river is ample for all purposes. From Gunnison to Chicken Creek, a distance of forty miles, the valley of this river averages three to four miles wide, and is similar in character to that farther south.

Leaving the Sevier and following the road over the ridge to the southwest, we enter an isolated basin, called Round or Lake Valley, which appears to have little or no connection with the water systems of the Sevier Basin. This is ten to twelve miles long and six or seven wide, but for want of water only a limited portion of it can be brought under culture by irrigation. There is probably sufficient to supply a strip of about a mile and a half in width, and there are some small grazing-fields. Passing westward out of this valley we enter upon the margin of the plains, which spread out with a gentle slope to the northwest. The little streams that run down from the mountains and pass off into the plains afford a belt of arable spots along the foot of the range, concerning which the following particulars have been obtained. Going south from the latter point, after passing some ten miles over the divide, we reach a little stream where there is a settlement and a small extent of irrigable land, and an area ten to twelve miles long and four or five wide, suitable for grazing sheep or cattle. Passing over a dry level plain for about eight miles, we reach Chalk Creek, bordered by a valley eight to ten miles long and about two miles wide, the greater part of which can be irrigated. Crossing another dry level of about four miles, we reach Meadow Creek, which has but little bottom land adapted to agriculture, and not sufficient water to irrigate more than a few hundred acres. It is probable, however, that a ditch could be brought around from Chalk Creek, by which a considerable area of the upper level could be rendered tillable.

Corn Creek, which is about five miles farther south, is flanked by a moderately-broad area of flat land, which can be irrigated to the full extent of the supply of water. Cove Creek Valley, about ten miles farther on, furnishes but little farming land, but contains some good grazing fields, and is already occupied to a considerable extent for this purpose. Five or six miles south is another small stream, (probably Pine Creek,) where sufficient land for a few farms might be irrigated. Passing over a divide of nine to ten miles, we reach Indian Creek,

a tributary of Beaver River, which brings us into another basin. Although there are two stage routes through this section, there is little known respecting its water systems; in fact, the very existence of Preuss Lake appears to be a matter of doubt, and future investigations may show that this is but a part of the Sevier River Basin. This is a different stream from the Meadow Creek, previously mentioned as coming down from Rush Valley. The most reliable information received tends to the conclusion that it is a separate basin, and that Beaver River, instead of running west into an imaginary Preuss Lake, bends around to the north, and after breaking through a low range of hills is lost in the sandy soil. Considering it as a separate system, it consists of Bear River and its tributaries, which rise in the western slope of the mountains before mentioned.

There is a considerable area of land on Beaver River that can be irrigated and cultivated, and the probability is that its breadth might be increased by extending canals on the upper levels below the mountain or ridge that crosses here. Passing over Beaver Mountain, we reach Yellow Creek, where there is a fertile belt, about ten miles long and six or seven miles wide, reaching from the creek to about two miles south of Parawan. Here and at Beaver River are some settlements and some land already under cultivation. Between Parawan and Cedar City there are a few arable spots, of small extent, which are already partly occupied. Cedar City is situated on Cole Creek, a stream about the size of the American Fork, which will irrigate four thousand to five thousand acres. Shirt's Creek, running by Kanara, is flanked by a considerable bottom, but the stream affords water sufficient to irrigate only a part of it. West of this, twenty to twenty-five miles, on another branch of Beaver River, are the celebrated Vegas de Santa Clara, noted as a resting-place after the fatigues of the desert march from the west. By following these various streams as they move north toward some common reservoir, it is probable a number of irrigable spots may be found.

Crossing over the divide, which here sweeps round in a semicircular form from a southwest to a northwest direction, we enter the valley of the Rio Virgin, a part of the vast territory drained by the Rio Colorado of the west. This stream, which sends down a considerable volume of water, is wide and rapid, and consequently shallow. It runs through an apparently barren country, here and there cutting through rocky cliffs and lava ridges, with occasional broad stretches of sandy land, covered with a very scanty growth of vegetation. Notwithstanding the unpromising appearance of this section, there are several settlements, some of which (as Washington and St. George) number several thousand inhabitants.

There are some very productive spots, and wherever water can be obtained, and the land irrigated, the soil becomes very fertile. The arable areas around Toquerville, thence up the river, are very limited, but about Washington and St. George they are more extensive, and the entire Santa Clara Valley for fifteen to twenty miles in length, and two to three miles in width, can be cultivated. One or two canals are being cut along the Rio Virgin, which will add considerably to the cultivable area. This section, on account of its semi-tropical climate, is considered by the Mormons of great importance, as they look to it for their supply of cotton, raisins, oranges, and other products which cannot be grown in Salt Lake Valley.

In regard to the vast regions east of the Wahsatch range, and south of the Uintah Mountains belonging to the Rio Colorado district, very little is known. Strawberry Creek, a tributary of the Uintah River,

runs through a very pretty valley for twenty to twenty-five miles, which averages seven or eight miles in width. The greater portion of this area can be irrigated, and would produce good crops. The Uintah Valley is more extensive, and has in it some very good land, a large portion of which may be rendered suitable for culture by irrigation, for which purpose the supply of water is ample.

CLIMATE AND PRODUCTIONS.

Within the Territory of Utah, every grade of climate, from the cold regions of the snowy Sierras to the semi-tropical region of the southern plains, is to be found, but the central portion, where the greater part of the cultivable land is situated, has a mild climate, corresponding very nearly to that of the middle States. Going north and northeast, ascending the mountain valleys, the climate increases rapidly in severity, and the growing seasons become shorter. Generally the annual fall of snow in the valleys is small, seldom more than a few inches in depth, and it remains on the ground but a few hours, or days at the farthest. In the vicinity of the higher mountains there are occasional injurious frosts.

Wheat, oats, potatoes, and fruit are the principal productions, which grow readily and yield abundant crops of the best quality, the soil being naturally adapted to their culture. Over one million bushels of wheat were raised in the Territory in 1866, but the ratio of increase since that time has not been in proportion to the breadth of land sown, as the grasshoppers have been very destructive for the past three years. Not only have they injured the growing wheat, oats, &c., but where the ground has been replanted for other crops they have in some instances cut the plants down for the sixth time in one season. The average yield of wheat per acre, in favorable seasons, is twenty-two to twenty-six bushels, but in certain localities it will reach much higher figures.

Cache, San Pete, and Utah Counties are the principal wheat-growing sections, not because they produce more to the acre, but because a greater area has been cultivated in this cereal in these counties than in others. It is probable that the superior flavor and lightness of the bread made from wheat grown in this Territory are partly due to the alkali with which the soil of the valleys is more or less impregnated.

As is generally the case throughout the Rocky Mountain regions, oats grow luxuriantly, the average yield per acre in the Territory being thirty to forty bushels. It is no uncommon occurrence for the farmer to cut an average crop of sixty bushels to the acre. Although a large amount of corn is raised, and crops of forty to fifty bushels to the acre are produced, this cannot be considered a good corn-growing country. There are many places where tolerably good crops can be raised, sufficient to supply local demands, but the corn does not compare favorably with that of the Mississippi Valley.

Sorghum grows finely, and it is probable that in this dry soil, consisting principally of silicates, and containing alkali, the production of saccharine matter will be greater than in soil having a larger proportion of vegetable mold. Whether beets, which grow large and fine in this part of the West, will produce a large per centage of sugar, has not been thoroughly tested on an extended scale.

Apples, plums, pears, peaches, currants, gooseberries, grapes, &c., can be raised in Salt Lake Basin and south with ease, but apples and peaches, especially the latter, will be the chief horticultural product. The average yield of peaches to the acre, as shown by the returns, is over three hundred bushels; and last year a lot in Provo, twelve rods

long and six rods wide, produced three hundred bushels. For the past three years the fruit has been seriously injured by the grasshoppers eating off the leaves of the trees, but the injury was less than it would have been in a section depending on rain to supply the requisite moisture.

As a grape-growing region this Territory cannot compete with California or Southern New Mexico, yet very fine grapes can be raised, and the Rio Virgin section can produce a quality equal to the grapes of any part of New Mexico, but the area is limited.

The potato grows to a large size, is of fine quality, and yields heavy crops. There are several fields of lucern, which is used to feed the cattle of the villages when the pasturage in the vicinity proves insufficient.

Very few of the valleys, except those in the mountains, furnish any timber of importance; but, as a general rule, a supply can be obtained from the neighboring ranges, chiefly pine and fir.

COLONIZATION.

The settlement of countries by colonies is by no means new. The children of Israel went to the land of Canaan as a colony. Athens and Rome were founded as colonies, and it is well known that much of New England was settled in this manner. Of late years few colonies have been founded, and settlements have been by individual effort. The laws relating to Government land require that titles pass directly to an individual, and no combined effort, no coöperation is recognized. Hence, when a colony undertakes to acquire a title to Government land, there are great difficulties; for, as soon as the location is made, squatters and land speculators rush in, and appropriate whatever lands they can seize, not in good faith, but that they may realize more or less on the rise in the price of land, caused by those who do come in good faith. Where there are railroad grants covering one-half of the region, the difficulties are proportionally diminished.

The objects to be secured in organizing a colony may be definitely stated: First, to secure choice and cheap land; second, to divide such land equitably among the members; third, to build a town, centrally located, that each may have a share in the increased value of town and of country property, and that there may be the advantages of schools, churches, and good society at an early day; fourth, to obtain reduced rates on freight and passage; and fifth, to prohibit the sale of intoxicating liquors and the introduction of gambling establishments. Theoretical ideas are of little value unless enforced by practical examples. The most noticeable recent example is that of the Union colony, the center of which is the town of Greeley, in Weld County, Territory of Colorado.

A visit was made to Colorado, late in the fall of 1869, by a gentleman interested in the formation of a colony, when the remarkably fine climate, the fertile soil, the abundance of minerals, and the majestic scenery attracted his attention. Almost every part of the United States had been previously visited with a view to impart information on the best localities for those seeking new homes on cheap lands, and it was seen that Colorado offered many inducements, an important one being its freedom from malarious diseases. But it was seen that to remove so far, in the common isolated method, would entail hazards of no ordinary character, and at the best it would be many years before the settler

would have schools and churches near him, while the expense required to prepare for emigration presented a formidable obstacle. The only plan promising much success was to organize a colony of several hundred families, that a large body of land might be acquired, and that the schools and churches might be built by a common fund.

Hon. Horace Greeley, having been consulted, entertained the proposition, and a call was made, December 7, through the columns of the New York Tribune. The plan of organization was substantially as set forth above, and the responses were numerous. December 23, a public meeting was held, and Mr. Greeley was appointed treasurer. A locating committee was sent out in February, 1870, various parts of the Territory were visited, and a selection was finally made, April 5, on the Cache à la Poudre, five miles above where it empties into the South Platte, twenty miles from the Rocky Mountains, and on the line of the Denver Pacific Railroad, midway between Denver and Cheyenne, fifty-five miles from each.

About twelve thousand acres of land were bought of the railroad company, and two thousand from preëmptors and squatters. The alternate sections, belonging to the Government, were to be homesteaded and preëmpted. In addition, a contract was made with the railroad for fifty thousand acres more, running for three years. The Commissioner of the General Land Office, at Washington, had been visited for the purpose of obtaining the privilege of having the Government land kept out of market until the colonists could go on from the States, and application was made to several members of Congress, but nothing seemed likely to be done, and the attempt was abandoned. However, a remedy was found, which was not at first fully recognized. As soon as the location was definitely made, a charter was taken out, under the territorial law of Colorado, for a series of irrigating ditches, which practically gave not only control of all the alternate Government sections adjoining those held in fee, but also of all the land, whether belonging to the railroad or Government, which the ditches might cover; for the company were empowered to charge such a sum per acre for the use of water as made them masters of the situation, and this has been made manifest by the fact that they are not troubled with squatters or speculators. Had the country been one where irrigation is not required, they would undoubtedly have met with great difficulties. The sum fixed upon for membership was $150, and $5 in addition for expenses. The number of members paying the full fee was about six hundred and thirty, and the total receipts by the treasurer, about $100,000. The land purchased was divided as follows: A section of six hundred and forty acres, a mile square, was laid off for a town, and divided into lots ranging from 25 to 200 feet front. Adjoining the town came, first, lots of five, next ten, next twenty, and next forty acres, each of which was appraised as being worth $150, and members were to choose which they would take. A member could homestead a Government half-quarter section, the fees on which would be paid, and have the use of water for his share, or he could preëmpt the same amount and have water. Thus far the smaller parcels have been considered preferable to the larger ones; but all are held in esteem, and plowing and improvements have progressed about equally over the whole domain. The lots within the town are sold to the members at $25 for inside, and $50 for corner lots, and the sums received are to be devoted to school purposes and general improvements. About one hundred lots are held in reserve, to be sold hereafter at an advanced price, for the use of schools.

Arrangements had been made with railroad companies at New York, Boston, Buffalo, Cleveland, and Chicago, for the transportation of the

colonists at a reduction in rates of about one-third, and early in May they began to arrive. The weather was cold, there were no houses, and, although a contract had been made for 70,000 feet of lumber, it was not fulfilled, and there was considerable suffering. The first relief was obtained in buying houses at a town five miles distant, and in hauling them to the ground with ox-teams; and a large building was bought at Cheyenne, and transported in sections on the cars. It was several weeks before any considerable quantity of lumber could be obtained, but finally there were large arrivals from Chicago and other points. For some time there was considerable dissatisfaction. All were strangers to each other, some were suspicious, and the officers were charged with inefficiency, neglect, and even with dishonesty. Much of the discontent was bred by those who expected to get a better chance than others, and much by the forbidding appearance of the country. Where irrigation is a necessity the grass has a brown appearance at all seasons of the year; and, as the ditch contracted for was not completed, many thought it doubtful whether life could be sustained. A visit to several ranches, a few miles distant, always dispelled the illusion. Water came into the town about the 1st of June, gardens and small fields were planted, and by the 1st of July vegetation grew with remarkable rapidity. Experience has demonstrated that the soil is remarkably fertile, and that if there should be any difficulty it will be in disposing of surplus crops; but of this there need be little fear, as the hundreds of mines and mining towns near by will always afford a good market.

The working of the official machinery of the colony has been reasonably harmonious. There have been jealousies, unkind remarks, ungrateful expressions, and some aspirations for position, but, in the main, matters have been kept well in hand. The locating committee received fair wages for their services; the superintendent was paid $7 a day until the middle of July. The president refused to receive any reward after the first week in May, and the only office to which any salary is now attached is that of secretary. The property is held in trust by a board of trustees, who grant deeds to members in fee whenever they make improvements on the land they have selected, either within the town or on their outlying land, and the charter for the irrigating ditches is held by them in trust. When members receive their deeds they are entirely independent of the colony, although they are members, inasmuch as each holds a certificate which entitles him to the use of water for all time; and in the election of officers he has one vote. No member can hold more than one share, and he can buy of the colony no more than one hundred and sixty acres of land; but few have bought so much. The sons and daughters of a member, if of age, can hold shares. The plan under which this colony was organized has worked extremely well, and in the formation of other colonies which are about to join it, without any charge above cost of land or charter privileges, only a few unimportant changes have been thought desirable. At the close of the year, that is, when the town was nine months old, there were nearly four hundred and fifty houses, many of them large and well finished; about twenty stores of all kinds, some of them first-class, both in regard to appearance of buildings and stock of goods; mechanics of all kinds, a weekly newspaper, three schools, and a population of at least one thousand souls. No liquor is sold in the place, nor is there a gambling establishment of any kind. Perhaps three-fourths of the members belong to some religious denomination. The navigation of the river on which the town is situated is to be improved for the purpose of floating timber from the mountains, and extensive saw-mills, as well as other mills are to be erected.

The experience of the colony in irrigation is favorable. It makes farming a scientific pursuit. The expense and labor are by no means formidable, and the colonists are found to adapt themselves to their requirements without any difficulty whatever. The incentive is, large crops; thirty bushels of wheat, fifty of oats, forty of barley, and two hundred and fifty of potatoes being a probable average. Finally, its success seems to arise mainly from adopting an organization that gives to the producer those profits which, under other conditions, are appropriated by speculators and capitalists.

CHINESE LABOR IN AGRICULTURE.

The public mind, within the last three years, has been much exercised upon the subject of Chinese immigration. Alarming predictions have been uttered as to the probable increase of this movement when once the starving masses of Asia shall have been attracted to it. Among these gloomy forebodings is the reduction of the wages of our own laboring population to the starvation prices of Asia. Speculations as to the influence upon our political institutions of the enfranchisement of these Orientals have not been wanting. Fears are expressed that our entire social system is to be overwhelmed by the sudden irruption of the great masses of heathenism, and the progressive forces of civilization are to be overborne. The movement, however, has of late received more careful study; and, as the facts of observation have been multiplied, not only have the intelligent minds of the nation emancipated themselves from their first apprehensions, but even the popular uneasiness has measurably subsided. The revolution which this importation of cheap labor is destined to work in our social system now promises to take place so quietly and so gradually, that even the most sensitive of our vested interests may not be seriously disturbed.

The movement so far has not assumed proportions at all alarming. According to the reports of the Bureau of Statistics of the Treasury Department, the total number of alien passengers arriving in the United States, during the period commencing with 1820 and closing with the third quarter of 1870, was 7,448,922, of which number 108,610, or less than 1½ per cent. were from China. The immigration from Japan and all other Asiatic countries could but slightly increase this proportion. This Mongolian influx was almost imperceptible prior to 1854. From 1820 to 1840 the number of arrivals was but 11. From 1841 to 1852, inclusive, the whole number was 35. In 1853 the report of gold discoveries upon our Pacific Coast seems to have made some impression upon the conservative Chinese, for in that year there were reported 42 arrivals, a number nearly equaling all the previous arrivals. The year 1854, however, witnessed a sudden enlargement of Chinese immigration, the aggregate number of arrivals being 13,110, a number not subsequently equaled until 1869. From 1855 to 1867 inclusive, the annual arrivals fluctuated between 2,500 and 7,500, rising in 1868 to 10,684, and in 1869 to 14,902. During the first three quarters of 1870 the aggregate was 11,051, showing a falling off of 20 per cent. as compared with the corresponding period of 1869. The immigration of Chinese females commenced in 1867. During the years ending June 30, 1867, 1868, 1869, and 1870, the arrivals were 8, 46, 974, and 1,116 respectively, making the total number of Chinese female immigrants, 2,144. The grand total

of arrivals of Chinese immigrants, male and female, during the last half century, is but about one twenty-fifth of the arrivals from Ireland and Germany alone during the same period.

In the character of these immigrants, and in the motives which are known to have generally prompted them to seek our shores, is found an ample quietus to the exaggerated alarm which this movement at first excited. Scarcely one can be found among these coolie immigrants who come hither with any purpose of permanent settlement. The Chinaman expects to return to the "Flowery Land" with a competence for life, the result of a few years of patient industry and self-denial in this land of high wages. It is stated that a capital of $300 is ample to enable the coolie, upon his return home, to live in comparative ease and independence, to enjoy among his untraveled countrymen the consideration of a great adventurer, and to move in a higher circle of society. But these worldly considerations are by no means the most powerful of the motives urging his return to his native land. His great desire is to be buried with his ancestors. To secure this point he stipulates with his employers, or with the Chinese associations with which he affiliates after his arrival in America, that, in case of his death in this country, his body shall be sent back to his native village for interment. The carrying trade in dead Chinamen has already attracted attention, and is increasing as the tide of immigration rises.

The feeling which prompts these stipulations is not a mere exaggerated patriotism; it is the outgrowth of religious faith. Though the Buddhist system, as explained by its authoritative expounders to the intelligent and educated classes, seems to be very deficient and intangible in its dogmatic basis, the common people have ingrafted upon it a popular mythology which secures the most unquestioning faith. The influence of this popular belief upon the family organization of this singular people deserves especial mention. Deceased relatives are always buried in a locality supposed to be under the care of an imaginary spirit of good luck, generally called "Fung Schuy." Under the inspiration and protection of this divinity it is believed that the spirits of departed ancestors will be able to exert a favorable influence upon the worldly affairs of their descendants. Hence the coolie desires to return to the locality around which these ancestral influences play. Again, the ancestor himself is dependent upon the offerings of mock money upon his grave by his descendants to enable him to purchase exemption from the tortures of the Buddhist purgatory. The coolie expects the same services from his descendants. This association of the interests of different generations gives the family organization a controlling influence in Chinese society. The practical effect is to destroy almost all desire of permanent expatriation. The law of the empire further makes this a capital offense; but under the diplomatic pressure of European governments interested in the coolie trade this law is now a dead letter.

The Chinese coolie seldom or never removes his wife or family from his original domicile. They are left to represent his home interest with his ancestral divinities. The women are still less inclined to travel than the men. Without any education or mental development, Chinese females cherish exaggerated terrors of the fierce "outside barbarians," and of the tempestuous seas. A number of higher-class females have arrived in this country, the wives of intelligent merchants and business men, whose belief in the popular creed is not more profound than that which the ancient philosophers cherished for the classic mythology; but of the laboring classes it is believed that not a single instance of this character has yet been reported. In regard to the recent remarkable increase in

the importation of females from China, there are painful facts of late development which show that they are brought to this country for purposes of public prostitution—a nefarious traffic in which both American and Chinese enterprise is enlisted. Women are at a great discount in China, as in all heathen countries. They are sold by their parents to escape starvation. The wife and daughters of a bankrupt Chinese are sold among his other *goods and chattels* to meet the demands of rapacious creditors. Many immigrants to this country were compelled to mortgage their families in order to pay their passage-money. But, as if this legal traffic did not suffice to meet the bestial demands of our Christian civilization, it is understood that a regular system of piracy in the river and maritime provinces of China overrides the weak local police and seizes whole villages, holding the rich for ransom, and selling the poor into slavery. This system of piracy was illustrated by a placard lately posted in the streets of San Francisco by a Chinaman, reciting the abduction of his sister by these wretches, and her transportation to a brothel in that American city. The facts were made public in a legal investigation. It is evident, that with the Chinese female immigration already secured, no permanent family organization can be expected, and that consequently the Chinese race will not be propagated in this country. Their continuance as a part of our population is then limited to the natural life of the immigrant. Nothing in their deportment points to any permanent assimilation with our social system. That the present aggregate of Chinese in this country will probably be greatly enlarged in coming years there is little room to doubt; but that they will become interested in our political affairs, or that they will ever amount to a considerable part of our population, does not appear from any facts yet developed.

Certain parties and interests in this country are demanding legislation which shall restrict or prohibit the further importation of these cheap laborers. It is not at all likely, however, that such unanimity of public sentiment will be secured as is necessary to secure this adverse legislation. By a majority of two-thirds of both houses of Congress, ratified by three-fourths of the State legislatures, all political disqualifications arising from "race, color, or previous condition of servitude," have been abolished. To revive in the case of the Asiatic the restrictions and disabilities that have just been removed from the African; to narrow down a broad principle of the universal brotherhood of mankind to which this nation was educated only through bloodshed and suffering, will require a majority equal to that by which the fifteenth amendment was ingrafted upon our organic law. It will require also a repudiation of the Burlingame treaty. It is scarcely possible that the American people can be persuaded upon mere theoretical consideration to repeal their late organic legislation, or to repudiate their public faith.

That the introduction of cheap Asiatic labor upon an extended scale may ultimately affect some of our industries is possible. Labor-saving machinery has been doing the same with every improvement that has been introduced, yet no one would now be willing to go back to the days of primitive, rude processes. It has been found that the disorganization of industry resulting from past improvements of this character has been but temporary and superficial—preliminary to higher organization of productive and financial interests. They have been found to elevate and ameliorate the laborer himself. Labor-saving processes save much of the drudgery which once oppressed the heart and brain and muscles of the toiling laborer. Machinery is now the *mud-sill* of society. While it has cheapened production by superseding useless and cumbrous processes of hand labor, it has, by enlarging production,

opened to the workman a higher and more remunerative scope of employment. English looms now represent the force of millions of men, yet English weavers are paid much larger wages, in comparison with the cost of support, than the Chinese and Indian artists, whose exquisite workmanship has lately been undersold in their own markets by the products of English machinery. It is within the recollection of persons now living that the introduction of spinning machinery into England was resisted by mob violence, as taking the bread out of the mouths of the laborer. It is believed that the alarm of the laboring population at the prospective rivalry of the Chinese is premature and unfounded. On the contrary, it is thought that the introduction of these cheap laborers, while superseding the hand labor of our native and naturalized population, in many elementary processes, will open up to the latter higher employment, based upon the increased production that will ensue. For instance, it is claimed that the immense mineral resources of Missouri were hindered in development by the lack of cheap labor, and that, with 50,000 Chinese, working with their mechanical regularity and low wages, an aggregate production of 600,000 tons could be secured—an amount equal to our total importation of iron. This immense mass of productive industry would give rise to more varied and intellectual employment for the native population. All the branches of manufactures into which iron enters as a constituent material, would feel the genial impulse of a cheaper raw material, and would afford their finished products at lower prices, thus stimulating consumption, and awakening a still greater demand in the market. All branches of trade and transportation would sympathize with the increased production, and would enlarge their activities accordingly, indefinitely expanding the field for employment of our intelligent native population, now laboring in less lucrative and less dignified occupations. Machinery has greatly alleviated farm labor, but not to so great an extent as in manufactures. Several of its heavier processes, especially in soil manipulation, await the results of inventive genius, which is now devising improvements. Until the drudgery of these elementary operations can be devolved upon machinery, they must still be borne by human nerve and muscle. The costly labor of our American population, applied to these rudimentary tasks, seriously narrows the profits of farming enterprise, and consequently tends to drive capital into better-paying investments. This again reacts against the interests of labor, by lessening the demand, and consequently cutting down wages. The American laborer is the most intelligent of his class in the world. With his increased intelligence a higher grade of wants and necessities is developed, requiring more abundant means of support. Any modification of our social order which tends to contract his means of subsistence is anti-democratic and reactionary. For the present the cheap Government lands of our public domain, and the wonderful liberality of the laws regulating their disposal, offer to the agricultural laborers of our older States a constant refuge against the pressure upon wages, by drawing off their surplus of laboring force. But, with the increasing activity of disposal, the time will come when the public lands will have passed into the hands of private owners, and this refuge of eastern labor will have been cut off. If our democratic civilization is to be maintained, we must before that time secure some other refuge, some reorganization of social forces, which will save the interests of the laborer and preserve to him his full share of the products of industry.

This problem in social science is, then, no less important to the laborer than to the capitalist. The question of present interest, however, is to

coördinate this new element of cheap labor in such a way as not to supersede the employment of higher-priced native labor. It is submitted that cheap labor will operate in the same general direction as labor-saving machinery; that, by cheapening production, it will open up more numerous sources of employment, of higher grade and of better wages. American labor, if it continues to hold its relative weight in its combination with capital, must develop increasing efficiency in producing results. If so, it must be emancipated from the drudgery of those elementary operations from which machinery has already partially relieved it. Labor must be more intellectual, and the native laborer must aspire to a larger share of the labor of direction. The employment of Chinamen will tend to secure these essential points. While relieving the American laborer from the rudimentary task-work of agriculture, Chinese cheap labor will impart an impulse to production, as machinery has done, opening new sources of employment. In these his conservative habits and his mechanical intelligence will forbid his rivalry with American labor. He is an excellent imitator, and will perform with the exactness of machinery the operations intrusted to him, but he has no vivacity of invention to lead him beyond those prescribed limits. These conclusions, though in a measure hypothetical, are supported by the agricultural and commercial press of the country in general, and seem to be gaining ground in public opinion. Of course, their real value can be finally tested only by experiment.

Leaving out of view such theoretical considerations, and estimating the experiment of Chinese labor in this country from the results it has already achieved, its success seems to be assured. The patient docility and remarkable facility of imitation of these immigrants enable them quickly to learn any routine operation. They have no wasteful habits, and hence the same amount of raw material goes farther in their hands than in those of the native or naturalized laborer. Their mechanical exactitude and singular carefulness in performing their tasks will go far to relieve the labor of superintendence. Their constant industry, plying their hireling tasks with as great diligence as though working entirely for themselves, makes their labor especially profitable. Their habit of boarding themselves relieves the family of the farmer from that invasion of domestic help which often imposes a serious burden, both of labor and of subsistence.

In the cotton industry of the South, and in the silk and tea culture of the Pacific coast, they find themselves especially at home. In these pursuits, requiring such an endless variety of manipulation, the careful and mechanical Mongolian will find special adaptation, supplying a kind of labor which can be obtained from no other source. He will in time adapt himself to other branches of agriculture, with results not less decisive. The experiment has been inaugurated, and from present appearances seems destined to receive a fair and full trial.

MODES AND RESULTS OF IRRIGATION.

The work of irrigation, a necessity of our agriculture in a large and promising portion of its area, is attaining systematic development, and assuming larger proportions with the settlement (and especially colonization) of the plains and mountain valleys of our Territories. The Union Colony at Greeley, Colorado, furnishes an illustration of the

latest modes of operation, the cost and capacity of works, with some indications of pecuniary results.

Going from the Eastern States, as the people of Greeley have done under the organization of this Union Colony, and being almost wholly an agricultural people, with no speculative views in regard to mining or other uncertain pursuits, a great problem was presented in regard to irrigation. It is to be understood that rain falls so seldom in Colorado that no dependence can be placed upon it in growing crops, except during March, April, and May, when there is either snow or rain sufficient to germinate the small grains. After this time the ground becomes so dry that any kind of planted crop must perish without irrigation. The only possible chance, then, for the farmer to grow profitable crops is to construct canals to convey the water of rivers in such a manner that it may be conducted over the fields.

Perhaps there is no more forbidding prospect to the settler than the necessity for an expenditure of several hundreds or thousands of dollars that the want of rain may be supplied, and the mind instantly suggests that there is a country where rain is always sure; but when it is considered that by means of irrigation crops are always certain, that the farmer bids defiance to the drought, and that the yield is nearly three times greater than elsewhere, it is apparent that great advantages may arise. In the case of the Greeley Colony, the cost of constructing irrigating canals has been from $1 to $3 an acre. The right to use the water has been attached to the real estate in perpetuity, with no other expense than the cost of repairs and superintendence. Elsewhere in the Territory and in New Mexico farmers make their own ditches as a neighborhood enterprise, which is practicable only when the ground is favorable; or, companies are formed and an annual water rent is laid, ranging from $1 to $2 50 per acre. In towns, such as Denver, the annual charge for water on an ordinary building lot is from $5 to $10. In Greeley an assessment has been made of $2 50 for each town lot, and $5 for five or ten acre lots, for the season, which will be amply sufficient to cover all expenses.

This colony early felt the importance of obtaining a knowledge of the best method of irrigation, so that, if possible, material mistakes might be avoided; and accordingly a farmers' club was established, meeting weekly, and correspondence was opened with intelligent cultivators in Colorado and Utah. Several gentlemen have also visited the club and given the results of their experience. Mr. Robert L. Kennison writes to the club as follows:

I resided in Utah about twelve years, and farmed some ten years of that time. When possible, we always prepared the ground in the fall, and sowed our wheat, oats, and barley as soon as we could after the frost was out of the ground, in the spring. At the time of sowing we prepared the ditches for each field. The advantage of sowing so early is, that it saves one, and sometimes two irrigations. In laying off the ditches to irrigate a farm, we first made mains from the public or company ditch, and in making them we kept on the highest land, paying no attention to section or other lines. Having our mains on the highest lands, we could easily irrigate each way from them. The mains being made, we laid off the field into lands or divisions, varying in width, according to the character of the soil and the lay of the land, from one to twenty rods. The divisions were always by small ditches, which were made by running a furrow both ways, and following with a wooden scraper made like an A. If our lands or divisions were dry for a long time, we generally preferred to divide them by running another main through. While more water is used by making ditches than by laying off the land by raising ridges, I think that the work can be done so much more rapidly and perfectly as to make it the better way.

I should advocate the irrigation of small grain by flooding. Supposing your field ready—the main and laterals all in order—we will commence by shutting down the gate or damming the main, so as to force the water on the land; and here I would say that the greater the amount of water in the main, if we can handle it, the better; but

no more is wanted in it than can be taken care of. The main, having been closed below, is opened at the highest part of the land, where, if the ground is level from side to side, and sufficiently inclined from the ditch, the water will soon find its way to the farthest end of the land. If, however, some portion is higher than the rest, the safety of the small ditches each side of the land is apparent; for then the center opening is closed, and the water let through the side ditches until it reaches the point of obstruction, when it is let out to flow on again; and this may have to be repeated again and again upon the same land, though generally there is no such trouble, the water flowing unobstructed over the whole. When the land has been fully flooded, the work is done and the water is shut off. If there are low places where the water stands, on the completion of the flooding, it is well to draw it off at once through the side ditches, which have come into use again. Beginners are apt to irrigate too early the first time. I do not think that small grain, if sown in season, will need irrigation until about the last of May, when, being in the milk, grain suffers the quickest from the want of water, and must then be well cared for.

Corn, potatoes, and garden vegetables we plant in rows, and irrigate by sending a stream of water between the rows. Potatoes are easily spoiled by flooding, and do not generally need water till in blossom. When the leaves of the corn curl up in the middle of the day it is an evidence of the want of water. There are indications of the need of water which can be learned only by experience, but the beginner is more likely to err in using too much than too little. In the irrigation of trees, avoid allowing the water to touch the tree, and shut off early in the fall, so as to give the wood a chance to ripen, and thus avoid winter-killing.

Mr. J. H. Latey, of the firm of Godbe & Co., writes that—

Too much water in the summer time causes vegetation to be yellow: if too little is used the leaves will parch; if applied too late in the fall it is said to be injurious to trees, as tending to promote growth which is endangered if frost suddenly sets in. It is almost impossible to wear out land, for the reason that irrigation brings out fresh soil and manure. The disadvantage is that it is very hard to keep down weeds.

Mr. L. K. Perrin, of Denver, makes the following statement:

There are two methods of irrigation practiced by the older farmers in this section, viz., flooding and soakage where the soil is light or does not bake; though I find very little of such soil adapted to irrigation by soakage, that is, upon which the object may be accomplished in a reasonable time. With grain almost every one floods, it being a much quicker mode. You inquire, "Shall we level our land so as to form beds?" Certainly not. It is too expensive, and is not necessary. Further, it is too laborious. We tried that plan years ago, and it has long been discarded. Most of the grain is put in with the harrow, and harrowed both ways, the last time going the way the water is to run, the water following the marks of the harrow in little rills. The dead furrow is very annoying. Sometimes, when irrigating, it will catch the whole stream, unless watched continually, cutting badly. Always have your main ditch on the highest ground possible. Irrigation should commence at the lower end of the ditch, thereby saving time in repairs; for, if commenced at the upper end, the water usually makes the banks of the ditch soft, and breakages are apt to occur, though that depends on the grade of the ditch. It is best to use as large a stream of water as the nature of the ground will permit to be handled with profit.

Some farmers, with clay lands, make a marker with cultivator teeth, placing them 18 inches apart, thus forming small ditches where little rills of water can flow, which will soak through to each other in twenty-four hours. This would not do for sandy soil, as they would be all together in a short time. The shovel-plow is sometimes used for making ditches in the grain-fields, but such deep and wide ditches will shake the good out of almost any reaper in harvest time. Cultivated crops should be put in rows, for then, with the shovel-plow to go between the rows, ditches may be made in which small rills of water can flow, and, if the ground is loose, the crops will soon be irrigated by soakage. After a crop has been wet, and the ground is dry enough to work, the cultivator should go between the rows, to prevent the moisture from baking out. A stream of water constantly flowing on a crop will not do any injury, if it drains off immediately. Standing water, with no outlet, will insure the loss of the crop. On side-hills, where the lands wash, we use four laths nailed together, which form a trough for the water to run in. They should be placed in the ditch, a rod apart, near the bottom, and the water can run night and day without injury. This plan is followed to considerable extent, as our land is rolling, and does not require much watching. You will not see the time, probably, when you will have to irrigate in the spring to get crops up out of the ground. We seldom have to irrigate before the first or middle of June. With the spade or hoe you can soon tell where water is wanted. Experience teaches us where water is needed, even from a distance, without minute examination of a crop. I would not irrigate fruit trees after the 15th of August. Dead furrows are a nuisance; and, if I were to start anew, I would outfit with the swivel-

plow. Sod land requires double the quantity of water needed on old ground, also much more labor; and if you average fifteen bushels of wheat per acre on sod, you will accomplish more than I have done.

If your ditch company issues water to its customers with any pressure, you must look out for leakage; that is, if you give your customers water with a five-inch pressure, the ditch will shrink one-third; so if your ditch carries 1,500 inches, you can furnish but 1,000 with such pressure. Less pressure, more water to furnish; greater pressure, less water. This fact we did not learn till this winter.

Captain Boyd, of Greeley, states that he has had much conversation with Mr. Eaton, who worked in New Mexico, where there is a light sandy soil, and flooding is generally practiced, and that he thinks this mode will have to be followed in Colorado. He adds:

Generally, the land lies to the south and east, and it is necessary to throw up several furrows. Much will depend on the fall of the ground and width of the lands. In flooding, a large amount of water is required, but a larger amount on ground quite sloping would have a tendency to wash away the soil; still the soil does not wash much. Mexican land is of a black color, not gray like that of the Platte. North of the river are several intervals of black soil. Water penetrates moist soil much more readily than dry soil, for the reason that particles of water have affinity for each other, and on the principle that particles of matter move more easily among themselves. We met the difficulty of a dry soil last year, and a long time was required to moisten it. A dark-colored soil absorbs heat; a light one reflects it; hence, mucky soil is more readily watered by furrows than a light soil. Muck contains fixed carbon or charcoal. The particles are separated from each other, and hence it is a powerful absorbent. Muck is analogous to charcoal, and the particles of water move through it as through sand. Where there are a great many pebbles and gravel, the soil is moist; they seem to have the power to raise moisture. If there is a gravel knoll, the water will generally rise to the surface.

Mr. L. K. Perrin furnishes the following in regard to irrigation in Jefferson County, Colorado:

The Table Mountain Water Company, of which I am superintendent, sell their water for $1 50 per cubic inch, to be taken out of the ditch with spouts or boxes at right angles with the ditch; no spout being allowed to take more than thirty inches in one body. These boxes are 3 by 10 inches in the clear, are set edgewise and just under the water, so that the center will give an average of 5 inches' pressure. Last year, and every year since the ditch was built, the water was run through a spout into a square box one foot deep, with holes cut 3 by 5 inches, giving a pressure of 5 inches over these holes, and each party was required to put in his spout and box. Some put in larger spouts, giving them a pitch of 5 or 6 inches in as many feet, and these being near the bottom of the ditch, the water came through in great force, and frequently the measuring boxes were found running over; hence we made a change to the effect of giving every one a spout just large enough to take what water he wants, and not give a chance to steal.

Under the old measurement system, the average supply for three or four years was three-fourths of an inch to a cultivated acre. Farmers putting in one hundred acres had 75 inches of water for the season. We sell from May 1 to October 1; that is, if it is called for so early in May. The water runs day and night, but not more than three-fourths of the time during the season. The average cost for water with us is $1 12½ an acre. On the old farms grain is not irrigated more than twice in a season; on many not more than once.

The Smith Ditch Company, of Denver, charge this year $3 an inch, measured in our way: for three previous years they charged $5 an inch. The farmers on Ransom Creek are charged $2 an acre.

Judge Osborne delivered an address before the Greeley Farmers' Club which seems to be specially applicable to Colorado farming. He said:

I came to this country to mine, and undertook it for about four months, and within that time I found the gold and silver very much mixed with rocks and dirt, and in many places hard to get at. I turned my attention to other business which was quite lucrative for a few months, and then I turned face about for the valley, and found "Paradise Lost" on Big Thompson. There I gave attention to stock-raising and farming, in which I have been quite successful, though not so much so as many that have had more means. I find there is nothing like sticking to business. The first year or two were seasons of experiment. I knew nothing of irrigation, and could not find anybody who did. I thought we could raise a crop on the islands and bends of the creek, and in fact thought it was the only land that was rich enough to produce. In 1862, 1863, and 1864 I farmed these lands, but that was the year of high water, which flooded my en-

tire crop, garden and all. The waters began to abate on the 27th of May, and I commenced plowing on the second bottoms, made garden, and put in an entire new crop, and have never raised a better one, and without irrigation.

Experience teaches me that fall plowing needs less irrigation than spring plowing, and that oats will stand more water than wheat. I reached these conclusions by experimenting, first with a crop of winter wheat, which I did not need to irrigate. The ground became well settled, and the wheat covered the ground before the warm, dry weather came on. I discovered that oats would stand more water than wheat in the season that grasshoppers visited us. I tried to drown them, but I could not, for they would crawl to the top of the oats and wheat blades, and bid defiance.

We can raise good crops here if we do our duty, and take especial pains to keep water in full supply. You cannot always tell exactly where the lateral ditches should run. A main ditch must be provided on the highest ground; but, in my experience, I have found it necessary to wait until water is brought on before establishing the smaller water-courses. I have run water-courses through grain after it was well up; and though this seemed wasteful, still, on the whole, it was profitable. It costs a great deal to irrigate, more than some represent; still, the large yield will pay for all outlays. I have raised wheat which was so heavy that in throwing my hat upon it from a distance it would remain on top. We find that our land does not require half the water, after a few years, that it did at first. I think that such land as you have should be flooded, and that it will not do to depend upon soakage. With a good head of water a man will do well if he can irrigate an acre a day. Do not undertake to irrigate with a small stream. Water enough must be had to keep a man constantly busy, and he must not stand waiting for the water to make its way, for it will do no such thing; he must keep along with the water, hoe in hand, conducting to this place and that, and see to it that every point of the field is watered. To turn water upon a field or garden and go off expecting it will do what is required, is useless; for it will make no progress, or it will run in wrong directions. It is true that, where the pocket-gophers are in the ground and have made passage ways the water will run for several rods, and irrigate well. Their work may be detected by the fresh dirt thrown up, but there are no visible holes. The work of prairie-dogs is different; they have deep holes, and water running into them will be wasted. Such holes must be stopped. I have seen no land in Colorado which will not yield well if water is applied.

Ground plowed in the fall will stand more dry weather than when plowed in the spring. I sow from ninety to one hundred pounds of wheat to the acre; and as many as ninety pounds of oats, and one hundred pounds of barley. In early sowing the grain soon covers the ground where it settles, and the water is more easily run over the surface while moisture is retained. Ground should always be rolled, to pack it on the surface. I once sowed oats without rolling, and only a part came up; then I rolled the whole, and it all came up.

Irrigating ground to start the grain I think impracticable, except on small pieces, as it would require a vast amount of water, far more than any one would suppose, and would keep busy four or five men to the acre. Therefore, we all depend upon snow and rain to get the grain above ground. I put my grain in deep, and prefer to have the ground rather rough until after sowing, when I harrow and pulverize thoroughly.

I sowed about two acres of timothy and clover, which did well. At first the clover occupied the ground; after that the timothy came in, and now there is no clover. I cut about two tons of timothy hay to the acre, and it is this which gives us the first green grass in the spring. Clover does best on upland. The weeds are a great cause of difficulty in getting a stand of grass on the bottoms; and I had to weed my timothy and clover. It will be several years before you will be troubled with weeds on the upland; need never be troubled if you keep them down as they appear. It is a good plan to sow timothy along your ditches; by so doing I am getting a good sod, while wasting is prevented.

We grow as good corn here as is grown anywhere, but the crop is not so large as in Illinois; I should say not to exceed an average of 25 bushels to the acre. We plant any time after the first of May. It will mature if planted by the 20th. One advantage with corn is that it can be put in and gathered when there is no other work; and after it is ripe it may stand in the field for years without injury. Corn will not mature without water. I should plant about five inches deep, and I have planted on sod, with a spade. A hand corn-planter does well. There is no use of planting corn in dry ground, for it will never come up. I find that it pays to do work well, and that when more work is undertaken than can be done well your labor is thrown away.

You will be likely to experience some trouble in getting garden seeds to grow. I have found it a good plan to lay boards on the rows, when seeds are planted, for moisture is drawn up, and the seeds are sure to start. When they are ready to break through remove the boards. It will not do to plant as shallow as in the States. When we commenced we knew nothing whatever of irrigation, and we were told to do this, and to do that, and there were a dozen ways. Something may be gained from our experience.

For our main crop of potatoes we depend first on the Neshannock, and next on the Early Goodrich. Of the first I have raised over 400 bushels to the acre; the average yield is 150 to 200 bushels. Bottom land will produce most, but on upland the quality is superior. Some cover with a plow, and others with a hoe, in well-prepared furrows. I plant in rows 3 feet apart and 18 inches in the row, harrowing just as they are coming up; then work with a double shovel, and lay by with a single shovel. The Early Rose has done well, but whether it is best for general planting or not remains to be seen. Potatoes are injured by being flooded; to run the water between the rows is sufficient. Last year I raised 1,100 bushels on the bottom, and did not irrigate at all.

We have had much trouble with grasshoppers, though not of late years, and we have learned so to manage them that our crops never fail wholly. I see there are no eggs laid this year; when they are laid it is a good plan in plowing to bury them deep. There are several kinds of grasshoppers, but there is only one variety which does any harm. When they came thick we used to open all the ditches, and conduct them on down as far as they could float, and thus the farms above were rid of part of them, at least. They never cover a whole county; and sometimes they destroy only a part or a corner of a field, and then suddenly disappear.

Mr. Elisha Evans, of Denver, finds objections to flooding land, inasmuch as on parts of the field water will be likely to stand and cause the ground to bake; hence he is in favor of making the ground as level as possible, and then using a machine which causes the water to run in little channels, a method which would seem to commend itself. He gives the following directions: 1st. Plow deep. 2d. Avoid "dead furrows" as much as possible. 3d. Endeavor to make your land level, and keep it so. 4th. Pulverize the soil thoroughly. 5th. Sow pure, good seed, and do it properly. 6th. Run your head ditches on a grade of not more than a half-inch per rod, and five to twenty rods apart. 7th. Run your harrow in the direction you wish to irrigate. 8th. When the grain is up and well rooted, the ground moist, (not wet,) roll at right angles with your head ditches. 9th. Commence irrigating before the crop begins to suffer from drought, and do not quit because you have a slight rain-fall.

THE NEW MEXICAN METHOD.

All the preceding directions refer to land which lies nearly level, or which with some little work can be made so; but it is manifest that when land is uneven great difficulties must arise in getting water over it. In New Mexico, where irrigation has been practiced over one hundred years, and where considerable uneven land has been cultivated, terraces or benches have been constructed. It seems, however, that in the course of time the best of the soil of the upper terraces is washed to the lower ones; hence much of such land has become quite poor. In the hands of skillful cultivators this evil undoubtedly can be avoided. Governor Hunt, living near Denver, has some land of this nature, which is used more for the purpose of growing clover than any other crop. We give his system of management:

My land being very uneven, I experienced more difficulty than those who may locate upon more favorable ground, and for this reason was compelled to divide it into small beds or lands of 15 to 25 feet, with back furrowing (to form a levee) from three to five furrows, and after that threw all the furrows down hill, and finished up with shovel and line; and, when completely and deeply plowed, dragging a heavy stick of square timber laterally from end to end of each bed, until all the little elevations were dragged into the depressions. I then harrowed it thoroughly, applied plenty of seed, and afterward rolled with a heavy roller. The most favorable time to seed is when the early spring rains are likely to fall, natural irrigation being far preferable for starting such tender plants. A top dressing of fine, well-rotted manure is of the greatest advantage in preventing the earth from cracking after the frequent flooding. In case the land descends in two or more directions, as is often the case, I divide these long beds into others of convenient size, each having a different level, and each provided with a bank or level on the lower side of sufficient height and strength to admit of flooding to a depth of two inches. If the descent is not too rapid it is much better to level each bed so that the water can stand of uniform depth all over it; but when this level-

ing will cut away too much of the surface soil, let the level be high enough to "back-water" over the upper side. My main ditch is arranged to throw its entire contents into the highest of these beds, through a sluice-box with gate. A few minutes serve to fill this, while the surplus water is discharged into the next lower bed, through a box constructed as follows: Take three pieces of inch board 12 to 15 inches wide and 2 to 3 feet long, nailed together like three sides of a box, braced across the open or top side. In this box I fasten a stationary gate, coming within three inches of the top. The box I pack in the levee so firmly that there will be no leakage around it, and of such height that, when the water has entirely covered the upper bed, the surplus will escape over this half-open sluice, falling in the box before striking the ground, by which the force of the current is broken and the water is thus prevented from tearing up the soil. By the same process a long succession of beds can be thoroughly and quickly watered without labor or waste; and also be made to do service while the owner is sleeping, and in case of a rainfall none is lost. When the last bed begins to fill, I shut the main gate and leave each bed of the series to soak away gradually. However, if the succession of beds is too long, the first gets too much water, and the last scarcely enough; therefore it is desirable to have a sluice-box for each bed, independent of the rest, connecting directly with the ditch. The larger the bed the better, for less land is occupied by the levees, and it is easier to work the land and gather the crops. If possible, employ an engineer to determine and mark the level for beds and levees, for much time and expense will be saved by it. The clover once up and once set, it is safe from everything except drought; and until it has grown enough to shade the ground somewhat, great care must be exercised to prevent its being burned up by sun and wind. After this water does the rest. In my own case this treatment has brought the following results: My first successful experiment was with a small piece of land measuring about one-eighth of an acre, sown one-half with common red clover, the other with lucern or blue Mexican. This piece supplied almost the entire summer feed for two cows, during three summers, being cut three or four times each season. In August, 1869, I sowed half an acre of common red, slightly mixed with white. This was well seeded, came up, and nearly covered the ground before winter set in. In the spring it began to grow at least a month earlier than the hardy weeds which had threatened to choke it out, and at last it smothered every weed and spear of wild grass which started among it. During the winter, while the ground was frozen, I had a small quantity of fine manure scattered over it, causing a perceptible increase in its thrift and nutritious qualities. I cut the third crop September 15, when it stood 12 to 15 inches high. From these crops I fed, from May to July 15, two cows and an average of four horses, and since the last date, five cows, eight sheep, and four horses, the clover forming almost their only food. Of course the horses were fed with grain, but the clover took the place of hay. The entire space occupied by clover will barely measure two acres; so you can form some idea of its enormous yield. No place in Colorado could be more unpromising than the very spot on which I have this year made three crops of clover. The soil was below the average of my farm in quality, but it has been flooded ten or twelve times during the season, and aided by the top spreading of manure. I have also had one crop from last spring's seeding, on ground which had no manure, irrigated as I have described. Of course this system of irrigation must be too expensive for large farmers, although during the present season I have taken more oats from one acre thus treated, than from four acres irrigated in the ordinary manner.

These experiments convince me that farming in Colorado resolves itself into a question of water and its judicious application. My own efforts have been confined to the sandy loam and gravelly soils, and I would apply this system only to such. Having had no experience in cultivating the heavy clay soils, I cannot speak confidently with reference to them.

From the experience of the Greeley colonists, which of necessity was imperfect, because they did not get water upon the land until late in June, Mr. Meeker concludes: 1st. Gardens require water at least once a week; grain, once in two or three weeks. 2d. The ground must be level, or free from elevations and depressions, and dead furrows should always be avoided. 3d. When water is to be applied, a large head is needed, so that the ground may be covered as quickly as possible. Half enough water is little better than no water. When irrigating is to be done, a man must be with the water all the time, for if left to itself, the work is certain not to be done. 4th. A great deal of judgment is required, and no positive directions can be given so that a man would not be under the necessity of adding something of his own knowledge, because no two pieces of ground are alike, and each requires especial study. 5th. Farming by irrigation is, on the whole, more profitable

than in places where rain is depended upon, because the yield of crops is increased, and because there must be large sections of land adjacent which cannot be irrigated, and which, being devoted to stock-growing, afford a good market for the comparatively limited supply. The certainty and exactness which enter into the pursuit of farming by irrigation tend to make it more attractive than when floods and drought take away a heavy percentage from the labors of the year.

One thing must be especially considered with reference to farming in Colorado, and also in the whole region of the immediate eastern slope of the Rocky Mountains; which is, that there are no fall rains as in Utah, California, and in all oriental countries. From September 24, 1870, to March 24, 1871, not a drop of rain fell, and but a slight quantity of snow; although within a distance of thirty miles, among the mountains, there were frequent rains, and in many places, in full sight, snow fell day after day and month after month, which, when spring comes, will melt and fill to the banks the many rivers and mountain torrents pouring out into the plains, giving through all the summer season abundance of water for the irrigating canals. This absence of rain during the fall and winter leaves the grass of the vast plains to cure into hay; and, remarkable as the statement may seem, it is still true that here thousands of cattle live all winter and grow fat without any other feed whatever.

The irrigating canals of the Greeley colony are the most extensive in Colorado, and they make an aggregate length of about forty miles; while of laterals there must be as many more miles, which will supply water for at least 30,000 acres. The cost has been about $45,000, but a considerable additional outlay will be required in bringing the water in small ditches to the several farms. Some years, however, will be likely to pass before the whole of this land will be brought under cultivation, for in making canals it is always important that they should have greater capacity than is immediately required. The size of outlying farms ranges from five to eighty acres. It is conceded that forty acres make a farm as large as one man can possibly cultivate, while it is granted that five acres will produce all the food that a common family can consume.

In a country so new and so rich in resources of every kind as Colorado, only a part of its capabilities can be learned at a time. The future prospect is extremely promising, and the possibilities of the country are likely to attract the attention of the American people for many years.

IRRIGATION IN TEXAS.

The following account of irrigation in the San Antonio Valley is given by Thomas H. Stribling, in a letter to the Commissioner of Agriculture:

The San Antonio Valley was first settled by the Spaniards about the year 1718. It was not until after 1740 that the principal works for irrigation were completed. They were projected and superintended by the missionaries of the (Jesuit) Dominican and Franciscan orders, the Indians of the missions established at various points in the valley doing the manual labor.

The irrigable portion of the valley has an average width of about a mile, but land has been irrigated for a distance of fourteen miles. The soil of the valley is a rich black mold, and very deep. The river bursts full grown from the base of a range of hills, about four miles above the city of San Antonio. From the springs to the city the fall is 44 feet; in the next ten miles about 40 feet. Two of the main irrigating canals, or ditches, as we call them, are taken out a few hundred yards from the head of the river, one from each side. They skirt the outer edges of the valley. A third ditch is taken from the San Pedro, a small tributary coming from the west. Many branches run from the main ditches, reaching every part of the valley.

The lands were granted with reference to irrigation. Indeed the grant of water (so many hours of water) was the prime object, and was in proportion to the amount of

land. A light tax was levied annually to keep the ditches in repair. There was, and still is, a ditch commissioner to keep the ditches in order, and see that every man gets his water at the allotted time, to prevent filching, &c. Fines are imposed for breaches of the rules. The time for irrigation is once in ten days, and the hours are fixed. Every man has his dam and gate, and when his hour arrives (the man above having finished irrigating and raised his gate) he lowers his gate, and at once the water overflows his land. A busy time follows. The water may seem very perverse in seeking its level, but hoe in hand, he trenches here and dams there, until all the ground is wet.

The land should be well prepared beforehand, and the rows, beds, &c., be constructed with reference to the ditch. Some skill is necessary to do this work properly, but it is soon acquired. There is no great mystery about it, and with a little experience and reflection all difficulty disappears. Ordinarily it requires about a third more labor to cultivate by irrigation than without it.

In old Spanish times five or six thousand acres were irrigated, but hardly half that number is now under irrigation. Three ditches taken out below the city are not now used, but they will soon be repaired and even new ditches made, and more land will be cultivated than ever before.

Irrigable land everywhere in the valley is worth $100 to $200 per acre, while adjoining land of the same soil, but not irrigable, is not worth $5 per acre. Sixty to seventy years ago wheat grown and ground here was packed on mules to supply the United States military posts in Western Louisiana.

The system of embankments, canals, &c., adopted by the Spaniards for irrigation, seems almost perfect, but their cultivation of the soil was rude. In one respect, particularly, it was very bad. They were always taking from, and never adding to, the soil. The idea of manuring never entered their heads. In the spring they raked up and burned everything above ground. Even now we cultivate badly, but a spirit of reform and progress is being awakened.

Much of our land has been improved by manuring. Three hundred to four hundred bushels of sweet potatoes per acre are not an extraordinary crop. Of sorghum sown broadcast for fodder I have known twelve tons grown on an acre, three cuttings a year. The ribbon cane grows to great perfection. Corn and cotton do well. Irrigation is of great value to orchards, shrubbery, ornamental trees, &c. For gardening it is of inestimable value. We have the greatest abundance and variety of vegetables almost the year round. All kinds of melons, cabbages, turnips, tomatoes, beans, peas, &c., are raised in great profusion. I know of no cheaper vegetable market in the United States. Beautiful streams of pure, clear water run through every part of our city, and seem to reach every man's door. They are the glory of San Antonio.

PRACTICAL NOTES ON UNDERDRAINING.

The following communication, from Mr. S. E. Todd, of New York City, embodies the results of his experience and observation in underdraining:

There are vast tracts of land which are cultivated every year, besides certain portions of cultivable land, which are not considered wet at any season of the year, the productiveness of which might be greatly increased by a system of thorough underdraining. Of course there are large areas which never did and never will require underdraining, as nature has made ample provision, in the character of the substratum, for the effectual removal of all the water that will not be retained by absorption. Whether the ground be underdrained or not, the surface soil and substratum will retain all the water that may fall on the surface, or that percolates through the strata from springs, until the greater capacity of the soil to absorb moisture has been reached. If good tile drains be constructed every ten feet distant, when the pores of the soil are filled, the surplus water will flow into the drains. There need be no fear that underdraining will render land too dry. The soil will hold all the moisture that vegetation requires. Many of our best farmers affirm that draining dry soils tends to promote desirable dampness during periods of dry weather.

During a discussion of the subject of thorough underdraining, at a legislative agricultural meeting at Albany, New York, one of the best farmers of the Empire State, who has had extensive experience in underdraining wet and comparatively dry tillable ground, stated that "an underdrained soil will be found damper in dry weather than if it had not been underdrained, and the thermometer will show a higher temperature in cold weather and cooler in hot weather, where the subsoil has been underdrained, than if no underdrains had been made." These facts are accounted for on the principle alluded to under another head, that, evaporation being a cooling process, and

moisture being absorbed from the atmosphere rather than yielded up to the dry air, the temperature is maintained at a higher degree than it would be if the water-line were nearer the surface. With the foregoing remarks we may understand what kind of ground needs underdraining, as well as what kind will not be sufficiently benefited to justify the expense of underdraining. Some land is only wet a little in the early part of spring, or during very wet periods in summer. Of course such ground would be benefited by a thorough system of underdraining only in proportion as it is too wet. Some ground may be so nearly "dry enough" that it would never pay to underdrain it, although underdrains would be of more or less advantage. The main, practical consideration is, what land may be improved in fertility to such an extent, by a system of underdraining, as to warrant the expense of excavating and filling ditches with tiles, stones, or wood. In most instances underdraining may be considered as a system of profit or loss. Where land is very cheap, and the products of the farm are sold at prices which barely cancel the expense of production, it may pay to underdrain certain portions of the cultivable land, and it may not. Of course there would be many modifying circumstances to affect the profit arising from the increased amount of products and the expense of making the drains. In case a tiller of the soil could not increase his crops in a few years in sufficient quantities to cancel the expense of making drains, it may be said that it would not pay to underdrain, although the productiveness of the ground might be somewhat improved by underdraining. On the contrary, where the price of land is high, and a ready market for farm products is at hand, it will usually pay well to underdrain land that exhibits only slight signs of excessive moisture.

1. Grass land, whether meadow or pasture, where red clover is lifted out by the frosts of winter, can be greatly improved by underdraining.

2. Any kind of land, where the cultivated grasses, such as timothy, (*Phleum pratense*,) orchard grass, (*Dactylis glomerata*,) or other upland grasses, do not grow luxuriantly, and where tufts and scattering spears of wild grass are coming in and crowding out such plants as should occupy the entire ground, may be greatly improved by underdraining.

3. Lands with a heavy and retentive subsoil, whether the surface-soil be a light loam, a mixed soil, in which black muck and leaf-mold constitute the predominating characteristics, or a light, clay loam, if the surface retains water in small ponds one or two days after a heavy fall of rain, should be underdrained.

4. Slopes of hills, where the subsoil is almost impervious to water, and where different strata crop out, between which water works out and saturates the entire soil at certain seasons, may be greatly benefited by deep underdraining.

5. Heavy, unctuous clay land, and any heavy ground which is to be appropriated to the cultivation of either spring or winter wheat, rye or barley, in case the surface is at all disposed to heave out the young plants, should be well underdrained by cutting ditches thirty to forty feet apart over the entire field.

6. Heavy land, or even light soils, where fruit trees are to be transplanted for orchards, if the water-line in the soil and subsoil is not at least three feet below the surface, should be improved by deep drains.

7. All land about dwellings and out-buildings of such a retentive character that water will stand in post-holes or in little excavations during the early portion of the growing season, as well as late in the autumn, should be well underdrained.

8. Land to be used as a flower or vegetable garden, where early produce is to be cultivated, should be well underdrained, as security against injury from protracted dry weather in summer, and the injurious influences of long and cold storms in the vernal months. Plants started in the growing season should not be exposed to a serious setback, arising from a long and cold storm, and a complete inundation of the mellow seed-bed. The same is true of most kinds of flowers. It will take them a long time to recover from the detrimental effects arising from a cold storm of ten days' duration, during which the roots have been standing in a soil saturated with "snow-cold" water. The water-line must be sunk at least thirty to forty inches below the surface.

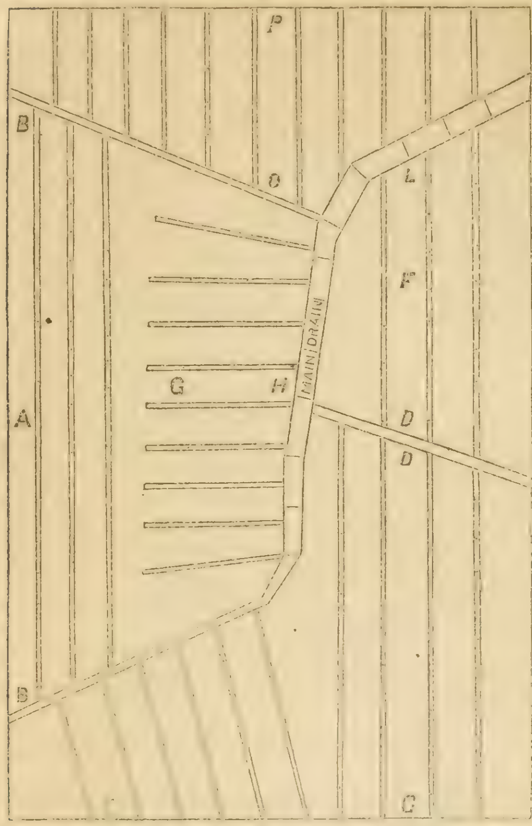
9. Deep underdrains should be sunk by the sides of highways, where the rolling wheels of passing vehicles frequently make deep holes and ruts which retain water longer than one or two days. Many a bad piece of highway may be made satisfactorily dry by simply sinking a deep underdrain on the upper side of the carriage track, to cut off all the surplus water that is constantly working down from the land above, and which keeps the bed of the road wet during most of the days of spring and autumn.

10. Shallow valleys and river flats through which small streams of water often wind and double, like the Mississippi River, rendering worthless a broad area of good land, should be improved by cutting a large ditch of sufficient capacity to carry any amount of water that will ever be likely to flow there.

11. Morasses, frog-ponds, fever and ague holes, and all low, marshy ground near human habitations should be thoroughly drained, and the land should be cultivated in some way or other, if nothing but grass be allowed to grow. Such places are almost

always a source of malarial disease. Nearly all can be drained at a comparatively small expense. After the surplus water has been removed, and the soil has been properly subdued and civilized by cultivation, such low ground often becomes the most productive and the most easily tilled of any portion of the farm.

Fig. 1.



Manner of laying out ditches.—The accompanying diagram, Fig. 1, represents a large field that was actually drained in the manner shown. The soil was a heavy clay loam, and the subsoil a retentive calcareous clay. The ditches were made about forty feet apart over the entire field. During a portion of the time a small stream of water that would all pass through a four-inch tile flowed over the surface in the valley from B to L, where a main ditch was sunk to a minimum depth of three feet, in which a course of four-inch egg-sole tiles was laid. As there was a valley at B O, and at D D, submains of three-inch tiles were laid as represented to connect with the main drain. The parallel ditches were then made up and down the slopes as nearly as practicable. From A the water would run most readily to B B. At G H short branches were made up the slope, in which one and a half-inch tiles were laid. At P O the ditches all ran directly up the slope. From F the water ran either toward the main L or the sub-main D. From C the descent was more uniform toward D D. Hence parallel ditches were made as represented. The object in laying out the ditches in so many directions was to have them extend, as nearly as practicable, directly up and down the slopes, which is the true system of thorough underdraining. Intelligent tillers of the soil and engineers of extensive experience agree in this one point, that in a system of thorough underdraining it is better to have the ditches made up and down a slope rather than diagonally across it. Hence main and sub-mains must be formed in the valleys, and parallels and branches should run up and down the slopes. Even when the strata crop out on the side of a slope, between which surplus water renders the soil too wet, it will always be found more satisfactory to cut the ditches up and down the slope, rather than in a diagonal direction across it.

Determining the size of ditches.—The size of a ditch must depend, in a great measure, on the quantity of water to be conveyed through it. When an underdrain is made in a valley through which passes a stream sufficiently large, during some of the months of spring and autumn, to fill a six-inch tile, the capacity of the underdrain should be fully equal to the volume of the stream when at its greatest height. If a considerable portion of the stream flows over the surface of the ground during the period of protracted storms, the ground will be liable to be gullied, and large quantities of the soil will be washed away. Previous to making a drain in such a place, it is an excellent practice to ascertain the capacity of the stream at high water, by making a temporary dam of sods, or with a board, and fixing a square tube made of boards in the dam, through which the water may pass. A drain will often draw four times as much water in one part of a field as in another. Hence, no engineer can determine with certainty, without practical calculation, what should be the size of the tiles or the capacity of the water-course to be formed. In case a stream of water is allowed to flow for only a few days on the surface over a stone drain, the water will be likely to find a passage

to the water-course of the drain, and will wash mellow earth down between the stones, thus obstructing the flow of the water in its proper channel.

It is always desirable, so far as may be practicable, to make the water-course of a drain only equal to the fullest capacity of the stream at any time. In many ditches, tiles having a bore of one and a half or two inches in diameter, will carry all the water that the drain will ever draw. In such places small tiles would be preferable to others twice as large, as a small passage, carrying a stream about equal to its capacity, will be kept clear longer than one much larger. Economy may be exercised, in many places, by laying tiles of the smallest size, say one-inch tiles, at the upper end of the ditch, for a distance of several rods; then, for another distance, lay one and a half inch tiles; then, as the capacity of the stream increases, use two-inch tiles, increasing to three-inch, four-inch, five-inch, at given sections of the distance. In many instances a stone drain or plank drain is made through a field as the main drain, or four-inch tiles are employed, into which not a few branches, some short and others long, empty their water. In many such branches one to two inch tiles would serve the purpose of four-inch tiles.

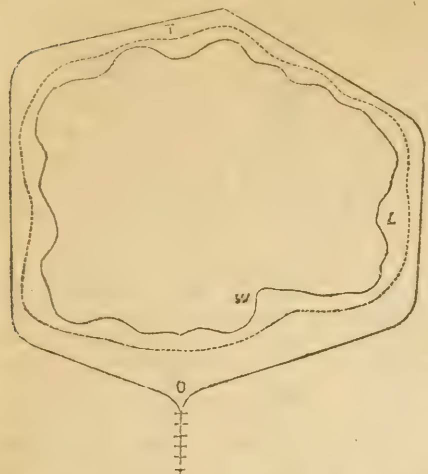
The size and form of the stones to be used in filling a drain must be taken into consideration when cutting the ditch. If the side stones are about six inches in diameter, and the stream seldom fills a four-inch tile, the bottom of the ditch should be made fourteen inches wide, which will give a water-course four inches up and down, and two inches wide. If the ditch be made of the size indicated, the same kind of stones may be used for covering the water-course that are employed in the side. It is important that the width of a ditch should conform to the size and shape of the stones.

Draining large marshes.—The first consideration in draining a marsh is to determine the source of the water. If the water backs up and overflows from a river, lake, or other body, the construction of a dike should be the first step. If the surplus water flows down from the uplands, or issues from springs near the foot of a slope, spreading over the surface of the low ground, a deep drain should be made between the slope of the marsh, called a "catch-water drain," for the purpose of receiving the water as it spreads along on the surface or through the soil at a period of high water. A good drain in the right place, near the source of surplus water, will often be more effectual in draining the soil than four times the length of drain made directly through the marsh. Marshes are always supplied with surplus water from a source higher than the surface. In many instances a small stream flows directly through the marsh during the greater part of the growing season, and at periods of high water the stream will be so large that the water cannot be conveyed in an underdrain. In such a case the first step will be to cut a broad, open ditch through the middle. This should be done when there is little or no water. In some instances laborers must do the first excavating in mud and water ankle deep. In case the natural course of a stream lies directly across a field, an open ditch, to carry the flood water, may often be made more conveniently on one side of the swamp, which will sometimes serve the double purpose of an open ditch and a main drain, into which branches may empty. If, for instance, as is frequently the case, a spring issues from one side of a swamp, so that the water spreads over the surface of a broad area, ascertain and stake out the most convenient place for a deep underdrain, to extend from the spring to some river, and let the water be all collected at the head of a ditch before any portion of it is allowed to spread over the low ground. One good drain will sometimes be sufficient to relieve several acres of all surplus water.

In many instances swampy depressions are found on table-land having no natural outlet of sufficient depth to draw off all the water, even in the driest month of the year. The source of the water in such "pond-holes" or "cat-holes," as they are sometimes denominated, can be found in no particular place, but it soaks in on every side. The proper way to render such places dry is to sink a deep ditch entirely around the outer edge, a rod or more distant from the high-water mark. Of course the distance of the ditch from the edge of the swamp will depend on the slope of the land. In case the land is dry enough to be plowed and cultivated close to high-water mark, let the ditch be made only a few feet from that point. On the contrary, if the partially dry land near the swamp is only a few inches higher than the level with high-water mark, and wild, coarse grass appears over the surface for a distance of several rods from the swamp, let the ditch be sunk a few feet beyond everything that indicates wet land. Such ditches should be made not less than three feet deep, having a good outlet, so that water from the farthest side will flow away as readily as from the side nearer the outlet. Fig. 2 furnishes a more correct idea of the true manner of draining "cat-holes" and frog-ponds on table-land. The irregular line W indicates high-water mark. The dotted line L represents the extreme point occupied by wild and coarse grass and aquatic plants. At O is the outlet of a tile drain, where it may be necessary to sink the main ditch four or five feet deep in order to secure a true descent from T to O on both sides of the wet ground. It is a rare occurrence that a cat-hole is not thoroughly drained when tiles are laid entirely around the outside, as indicated. The grand difficulty in many instances is that the ditch is sunk on one or both sides of the wet ground *deeper* than

at the outlet. It is an excellent practice to grade the entire ditch before laying any tiles; then let in the water at T to test the descent. In case the water does not disappear from the swamp in a few weeks after the tiles are laid, let another ditch be made directly through the pond.

Fig. 2.

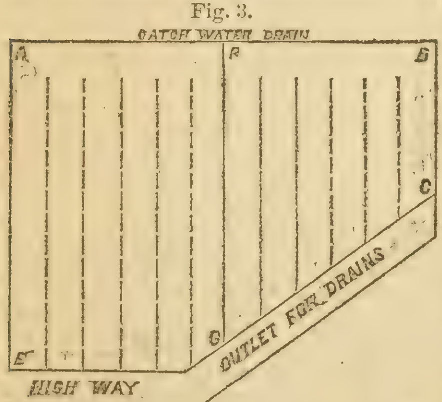


Another difficulty of common occurrence, when swamps are drained, is that the ditches are made *too shallow*. In case a frog-pond covers an area of only a few square rods, and it is a long distance from and nearly level with the final outlet, it would be allowable to sink the ditch at T only two feet deep. Still, if the bottom of the ditch can be graded with only two inches fall in every one hundred feet, it would be desirable to sink every part at least thirty inches in depth.

In most instances one-inch tiles will be sufficiently large to convey all the water that would be collected around a pond occupying half an acre to an acre. In some instances two-inch tiles will be required, with those having a two and one-half inch caliber for the main drain. If tiles are somewhat expensive, many dollars' worth may be saved by employing those of a small size when there is only a small quantity of water to be conducted.

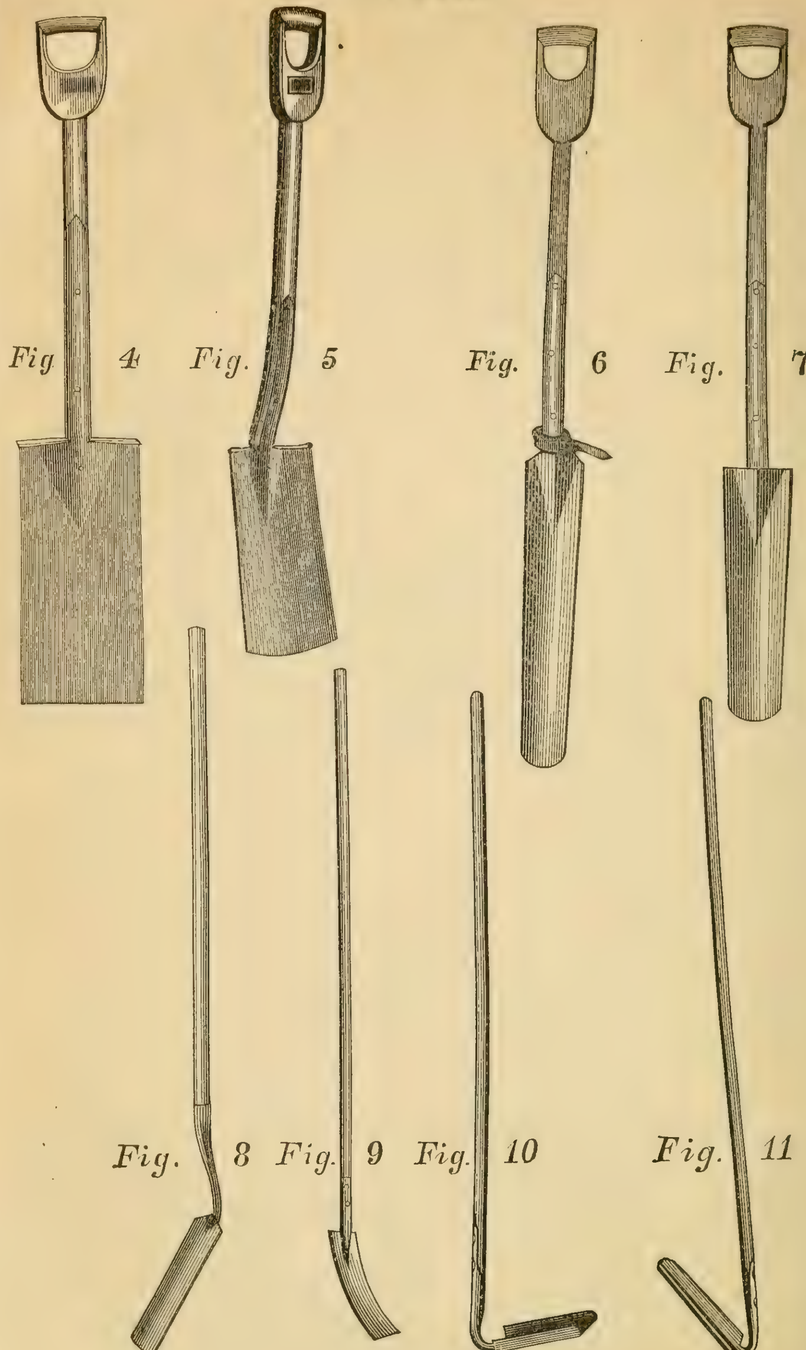
Thorough draining of slopes.—On the table-lands between many of our lakes and rivers there will be found large swamps, and in some instances extensive ponds, many of which never dry up, even during the summer. In numerous instances the water from these swamps percolates through the strata below, and spreads far and wide in the fissures until it reaches the surface soil on the slopes, which it keeps thoroughly saturated, even in dry weather. In one such instance, a type of many others, a field lay on a slope, as in Fig. 3, above which, on the table-land, was a large tract of swampy ground, chiefly woodland. This slope descended about six inches per lineal rod; and there seemed to be no reason why the soil should be so wet when such land ought to be dry. The entire slope, over an area of many acres, was rendered very wet by the water that came to the surface from the swampy land above.

Fig. 3.



The first step toward draining that field thoroughly was to sink a three-foot ditch, with a stoned throat, across the upper end from *a* to *b*, from *b* to *c*, and from *a* to *e*, letting the water discharge into a deep gutter at one side of the highway. As there was a low place at *f*, a ditch was sunk from *f* to *g*. The deep "catch-water drain" across the upper end, from *a* to *b*, cuts off a large proportion of the water. Yet six or eight yards down the slope the water would soak out from the catch-water drain, rendering the soil on the lower side of the slope as wet as ever. It is probable, also, that the veins which conducted the water from the swamp to the lower part of the field were not yet reached by the catch-water drain *ab*. Hence other drains were made about forty feet apart, as shown by the dotted lines up and down the slope, ending four or five rods below the catch-water drain. These latter drains collected the surplus water in the most thorough manner. For the catch-water drain two-inch tiles would have been preferable to stones, and one-inch to one and one-half inch tiles would have been sufficiently large for the parallels, as represented by the dotted lines. At *e* was the lowest point. Hence, if there had been no deep highway gutter along *c*, *g*, *c*, it would have been necessary to make a drain in that place to receive the water from the parallels. As the slope below, which was wet also, belonged to another person, it would be necessary for him to sink parallels directly up and down the slope, ending two or three rods below the highway, if he would carry out the system of thorough drainage commenced above the highway, as represented by the diagram.

PLATE XXXII.



DRAINING IMPLEMENTS.

Excavating small ditches.—The most economical and expeditious manner of excavating ditches of ordinary size is to stake out the course of the ditch, using many short stakes not more than a foot high, and three or four long ones; then, having put a sharp point and a sharp colter on a common two-horse plow, strike a straight furrow, only four or five inches deep, in case the surface is covered with turf, and let the furrow-slice fall back again into the furrow. If the furrow-slice does not return to the furrow, let it be turned back with iron hooks. Now let the plow be run back in the same place, so as to cut a furrow-slice about ten inches or one foot in width, which the plow will throw entirely out on the bank. A good plowman will remove all the "first spading," by operating in this manner, faster than twenty men can cut the turf and throw it out with spades. In case the first furrow-slice is not of sufficient width for a deep ditch, let the plow be run along back and forth to cut off another furrow-slice of the desired width. If a double team can be employed, where the land is not stony, a depth of six or eight inches may be thrown out with a plow. Should there be much loose earth after the sod has been removed, let it be shoveled out with round-pointed shovels; then drive a common plow, without a colter, back and forth in the excavation, until the implement has loosened a depth of nearly two feet. After the mellow earth has been thrown out with shovels, hitch a team to a subsoil plow and loosen the hard under-stratum, and continue to plow up and throw out the earth until the desired depth has been reached. The writer has sunk many hundreds of lineal rods of tile ditch in the foregoing manner, the expense of which did not exceed eight cents per rod. The bottom must necessarily be graded with a ditcher's pick if the ground be very hard. It will be understood, also, that after the excavation has been made over a foot deep, a long whiffletree should be employed, so that each horse may travel at least two feet away from the bank of the excavation. A chain also, two or three feet in length, must extend from the end of the plow-beam to the double whiffletree. When the sod is removed with spades and shovels, a vast amount of hard labor may be saved by making the ditches as narrow as they can be excavated, as a narrow cut across the water veins will stop the onward flow of water, and conduct it to the bottom of the channel quite as effectually as if an excavation were made in the same place one foot wide. If, for example, the ditches are to receive two-inch or even three-inch tiles, and the excavating is all to be done by hand tools, let a line be stretched, say, fifty or a hundred feet in length, and with the spade cut through the sod beneath the line. Then remove the line eight inches distant, and cut the sod for the other side of the ditch. If the ground can be spaded, a digger will be able to excavate from ten to twenty lineal rods in a day, according to the compactness of the subsoil. As the ditch is sunk, the sides should be dressed off roughly, merely to keep the banks true, and tapering to a width of only four or five inches at the bottom of a ditch thirty inches deep.

An experienced ditcher will probably demur at the idea of working in such a narrow excavation. The writer once employed a digger who made true ditches, but he had been educated to excavate ditches for receiving stones, and he would not cut less than one foot wide at the surface and ten inches at the bottom. He would not be convinced that an excavation only seven or eight inches wide at the surface, and four or five inches wide at the bottom, could be made with about one-half the labor. When excavating such narrow ditches the digger must be provided with a good narrow spade and a ditcher's scoop. Then he must learn to work with one foot forward of the other.

Ditching implements.—There is a great difference in spades. Some are made of the poorest kind of rolled iron. The blade of such spades must be very heavy to endure severe usage in the hands of careless laborers. Besides this, they will not wear smooth; and the blades cannot be kept bright without much difficulty. Hence, iron spades are heavy, unwieldy, and always so rusty as to hold the earth, thus making hard work still more laborious. Figs. 4 and 5 represent two steel ditching-spades, of the most approved forms. Fig. 4 represents a steel spade of extra length, ironed extra strong on the handle. Fig. 5 shows a concave blade, having a circular edge. This spade is made of good steel, properly tempered and polished, and is much lighter than the other, although very strong. This concave blade is used in removing the first sod-spading, when excavating narrow ditches for small tiles. Fig. 4 is designed for digging in heavy, unctuous clay, where a tool of unusual strength is requisite. To work easily, steel spades should be kept bright on both sides, and the blades should be ground to a sharp but abrupt edge. If spades of the desired length and breadth of blade cannot be obtained readily at country stores, the nearest manufacturer of spades and ditching tools could be addressed, with directions for making tools of the desired form and size.

Fig. 6 represents a spade of the latest improvement. The blade is twenty inches long, five inches wide, and circular at the entering edge. This style of spade is designed especially for excavating deep and narrow tile ditches. The handle is longer than the handles of ordinary spades. The blade is concave on the front side, and is usually made of steel neatly polished. As the shoulder at the head of the blade is quite too narrow to receive the digger's foot, an iron adjustable shoulder is held by two screw-bolts to any desired place on the handle. With such a spade, after the

first spading of soil has been removed, a digger can sink a ditch to the desired depth while standing on the bank. Fig. 7 is a steel spade similar to Fig. 6, yet having a shorter blade. Fig. 8 represents a very convenient and useful tool for shoveling the loose earth from the bottom of ditches that are of sufficient width to receive the blade. The corners of the entering edge are made square and sharp, to facilitate dressing out the corners of the bottom of a ditch.

Cleaners are valuable and convenient tools to aid in excavating very narrow ditches. They are of several forms, as represented by the accompanying illustrations. Fig. 9 should be hung similar to a round-pointed shovel, so that the blade will rest flat on the ground when the handle is held across one knee. The blades of the other cleaners, Figs. 10 and 11, are hung at about the same angle as a broad hoe, so that the operator can stand on the bank of the narrow ditch and scoop out the loose earth from the bottom. In many instances where the earth to be excavated is soft, these cleaners are employed to excavate the ditch after the first spading has been removed, and to grade the bottom while the operator stands on the bank. Fig. 11 is a slender scoop having a long handle.

The blades of such cleaners should be made of good steel, with a strong shank and a handle that cannot be broken by a careless thrust. It should be remembered also that such cleaners are not designed to endure the strain of a pick or a crow-bar. Hence the edge should not be driven down into compact ground, and force applied to pry more earth than the tool can lift at one time. All such tools are made strong and light, to handle loose and yielding earth. But diggers who have not been educated to use tools with care will often employ a cleaner when they should use a crow-bar.

A boot spading-iron.—After the spade has been used for a few hours, unless the sole of the boot is unusually thick and hard, the foot which is employed to thrust in the spade will become tender and lame. To prevent such an occurrence, all skillful ditchers employ a spading-iron, to be lashed to the hollow of the foot.

A Convenient Drain Level.—A convenient level is an important instrument to be employed when making drains. When there is only an inch fall per lineal rod, the use of a reliable level is requisite to grade the bottom of the ditch at a true inclination, so that the water will flow away without being forced along on a level in certain places. The surface of the land is often deceptive, so much so that it is frequently unsafe to depend on cheap *spirit* levels, much less to rely on random guessings.

Fig. 12.

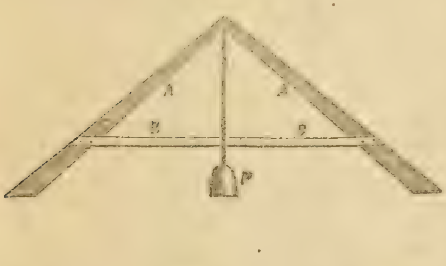


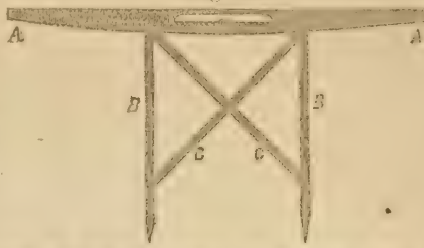
Figure 12 represents a wooden level that a mechanic can make in half an hour; *a a* are pieces of light wood one inch thick, eight feet long, four inches wide at the lower ends, and two at the top; *b* is a graduated cross-bar, screwed to *a a*; *p* consists of a plumb and line. Before the graduated scale is made on *b*, let the level be turned half way around. If the plumb-line indicates the same point or mark, the level is practically correct. Let the pieces be planed and painted, and the joints glued together. Then let it be handled with care and housed from the influences of the weather.

Ditchers' Metallic Shoes.—When laying tile in a narrow ditch in which there is a stream of water, it is very desirable to have a pair of metallic shoes lashed beneath the feet. These are usually made of thick sheet iron, with the two edges riveted together at the bottom. The object of such shoes is to allow the water to flow through the orifice freely, without forming a pool of water directly where the operator is laying tiles. When a ditch is only wide enough for a man's feet when one is directly forward of the other, they will obstruct the water, rendering it rather disagreeable for the ditcher. When the bottom of a ditch is soft, the feet of a heavy man will constantly poach up the soft earth, making it more difficult to lay the tiles properly, while the hollow shoes will aid materially in keeping the bottom true and smooth. The orifice through the shoes need not be over two inches deep by four inches broad. Leather straps may be riveted to the sides, or they may pass through the sides. The shoes should be about two inches longer than the boots of the operator. A block of hard wood three by four inches square, with two one-and-a-fourth-inch holes bored through lengthwise near the bottom, will serve the purpose.

Spirit-levels.—Many spirit levels are not sufficiently correct for leveling the foundation for a building, nor for grading a ditch where the surface of the ground is nearly level. In many instances the *vial* which contains the *spirits* is of such form that the air-bubble will not indicate a trifling movement. But a plumb-line will never fail to correspond exactly with a water-level. Fig. 13 represents a cheap and convenient spirit-level, which a worker in wood will be able to make in an hour. The part repre-

sented by *A* should be about eight feet long and five inches wide at the middle; *B B* are legs three or four feet long, and *C C* are braces. The spirit vial is set in a recess, cut in the middle of *A*. A joiner's "spirit-level and plumb" may be fastened to the side of *A* with two screws. Then the sight is taken over the upper edge of *A*. In some instances, if there is no wind to blow the plumb-line, and one has a *true* steel square, he may strike a level pretty correctly by placing the long part of a steel square on two stakes and plumbing the arm of the square as it hangs down. A small thread should be employed as a plumb-line for such a purpose.

Fig. 13.

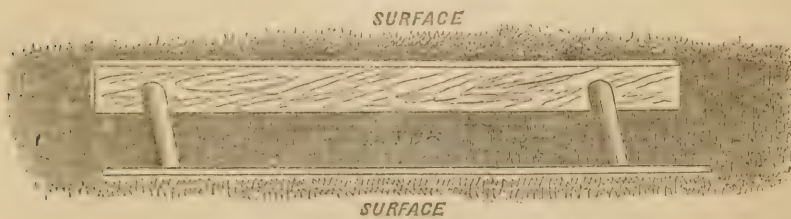


Shovels for ditching.—Every laborer who shovels earth, whether from ditches or other excavations, should be provided with a good steel round-pointed shovel. If the handle be of the proper curvature, so that the blade will rest almost flat on the ground when the handle is dropped across one knee, a large proportion of the labor and consequent fatigue will be avoided, as one knee can be employed as a fulcrum to lift the shovelful of earth without employing the muscles of the back. With such a shovel properly hung, a laborer will be able to throw out more than twice the amount of earth from a ditch, with less fatigue, in a day, than with a common dirt-shovel having a short handle. When excavating narrow ditches one inch or more may be turned up on each side of the blade, or it may be cut off, making a blade five or six inches broad. When a digger must bend his back to enable him to get down to the dirt, every time his shovel is thrust in, the fatigue resulting from the elevation of the body and bending down also will exceed the fatigue arising from the expenditure of the force employed in shoveling. A laborer must keep the back straight when shoveling, or his power of endurance will soon fail.

A ditchers' steel pick.—On many farms the substratum is so compact and full of "hard pan," and small stones imbedded in the rock-like earth, that the best steel spade will scarcely enter one inch. For excavating such land, a ditcher requires a good steel-pointed, double-bitted pick, one end pointed four square, and the opposite end chisel-shaped, about one and a quarter inch broad. The best quality of steel should be employed; the temper should be as hard as the steel will bear to be made without being brittle. As steel varies so much in quality, no particular rule can be given as to tempering the pick. The maker or the blacksmith must "temper and try." The end of the handle that enters the eye of the pick should be large, strong, and dovetailed, so that the end can be kept tight in the eye without difficulty. Such handles should be made of the best quality of hard and tough timber; and the large end should be soaked in linseed oil two or three days before it is used, to render the timber durable, and to prevent shrinkage and working loose.

Excavating very deep ditches.—It frequently occurs, in cutting a large main ditch, that it is necessary, at certain places, to sink it five or six feet deep, in order to make the bottom of a uniform grade. When cutting a ditch through some kinds of ground, unless the banks are left so sloping that the earth cannot cave in, a great deal of labor is required in throwing out much more earth than is really necessary. To avoid this, after the surface of the ditch has been excavated about two feet in depth, procure two wide planks sixteen or twenty feet long; place one on each side of the

Fig. 14.



excavation, and drive in a brace or prop between the planks, as represented by Fig. 14, in which a large plank is shown, placed against the bank of a ditch, with two props extending across from one plank to the other. A width of two feet will enable a dig

ger to sink the excavation five or six feet without incurring any danger from caving. By employing the level, Fig. 12, and grading the bottom of a section one rod in length of the correct inclination, and laying the tiles or other material, as soon as about twenty feet can be excavated, the earth can be returned at once, and the props be removed to plank another section of the ditch. When the banks are stayed for a long distance with planks and props, a large quantity of lumber will be required. Besides this, the injury done to clean planks, when employed for such a purpose, would render them of little value for most building purposes.

Finishing the bottom of a ditch.—When tiles or stones are employed to fill a ditch, it is of little account whether the sides, a few inches upward from the bottom, be dressed true or left as uneven as a rough rock; but when filling with pieces of plank, it will be easy to finish the sides and corners of the bottom so smoothly that the pieces will fit neatly by using a gauge, represented by Fig. 15, which consists of a piece of hard-wood board ten inches long by four inches wide, having one end of a handle nailed firmly across the middle, as shown. When finishing the bottom of a ditch, the ditcher should be provided with such a gauge, and be instructed to have the bottom of the ditch dressed so true that the gauge will barely pass through it endwise.

Fig. 15.

The correct depth of drains.—Where the ground is to be cultivated by deep plowing, or by spading, whether the ditches are filled with tiles, stones, or wood in any form, the excavation should never be made less than thirty inches deep. No plowing or spading will ever disturb the tile in a ditch of this depth. If a ditch is stoned, so that the surface of the leveling stones is ten to twelve inches above the bottom of the ditch, a suitable plow might disturb some of the stones, and cause mellow earth to work down into the water-course, and thus obstruct the stream. So long as a drain has a free outlet, there is little danger of sinking a ditch too deep.

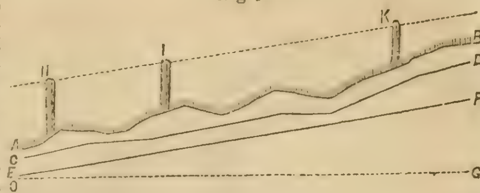
The rule adopted by all intelligent ditchers is, to sink the ditch at the most shallow place, not less than thirty inches; then, if the ditch will draw all the water when graded to that uniform depth, thirty inches will subserve the purpose as well as if the drain were three or four feet deep. After a ditch has been sunk thirty inches, any farther depth should be determined by the distance required to cut off the water-veins. The only objection that can be urged against a greater depth than thirty inches is the expense of digging. When the earth is so firm that the lower part of a ditch must be dug up with a sharp-pointed pick, it is estimated by practical ditchers that the labor of making a ditch four feet deep is fully equal to cutting two ditches, in the same kind of soil, only three feet deep. This assumption will not always be found reliable. If a ditch be excavated to the depth of three feet, while it is of sufficient width to enable the digger to sink it another foot without increasing the width, it is evident that the labor required to excavate the fourth foot will not equal the labor of sinking it three feet. If the ditch is so narrow, after having been sunk three feet, that the digger cannot work conveniently at a greater depth without increasing the width, the labor incident to excavating the fourth foot may equal the expense of digging the first three feet.

Most writers on underdraining have fixed the minimum depth of drains at four feet for all ordinary underdraining, but none of them have assigned any plausible reason therefor, except that it brings the line of saturation farther below the surface of the soil than the same line would be in case the drains were only three feet deep, which is correct. Yet, if a system of draining thirty inches in depth draws all the superfluous water, we are not warranted in assuming that the soil would be any more productive if the drains were sunk four feet deep. The roots of growing plants will not strike more than thirty inches deep, on an average, even if the ditches were sunk six feet deep. Hence, we shall need the evidence of well-conducted experiments to prove that it will pay to sink ditches four feet deep, before recommending the adoption of so expensive a system.

Grading the bottom of ditches.—When there is considerable slope to a ditch, it is important that the bottom should be of uniform descent from the summit of the slope to the lowest point of the outlet. This is particularly desirable if the ditch is to be filled with stones, planks, or horseshoe tiles, in which cases the water flows on the ground; and if the earth should be soft and readily washed away in some places, and be compact in other places, the bottom of the channel would be liable to be gullied where the water runs most rapidly. The object in having the bottom of a true grade is to secure a uniform current of the stream. The subject may be elucidated by the accompanying diagram, (Fig. 16,) in which *a b* represents the uneven surface of the slope, where the drain is to be made. There may be, for example, a marsh a little above *b*, to be drained. Instead of making the bottom of the drain to correspond as nearly as may be with the uneven surface of the slope, as represented by the line *c d*, of numerous angles, the bottom should be graded as straight as a line from *e* to *f*; then water will flow from one end to the other with a uniform rapidity. A horizontal base-

line at the outlet of the drain is represented by the dotted line *o g*. To commence properly, drive a stake three feet high at *h* and one at *k*, where the ditch is to be cut; then drive another at *i*, so that the tops of each will be in an exact line as represented by the dotted line beneath, *h i k*. The stakes at *h* and *i* must be just far enough apart to support the two legs of the level, (Fig. 13.) After the stakes, *h i*, are driven, place the level on the top of them, and make a mark on the cross graduated bar at the point where the plumb-line settles while the rule is on the tops of the stakes; the ditcher will then have a cheap and reliable rule to enable him to grade the bottom of the ditch with the most desirable accuracy, at any point from *a* to *b*. Let him commence at *a* and sink the ditch as deep as the outlet can be dug; set the level in the bottom frequently until the correct inclination is secured; then, if there should be any danger that either bank will cave in, let the tiles, planks, or stones be put in the bottom and covered with dirt at once, when the digger can proceed to excavate another lineal rod, and grade the bottom with as much accuracy as it could be done were all the ditch excavated before any portion of it is stoned or tiled.

Fig. 16.



Different styles of ditching-plows.—By employing strong teams and plows of proper construction, a vast amount of manual labor may be avoided. A steel mold-board plow with a sub-soil attachment is employed in many States both for ditching and pulverizing the soil, where the substratum needs to be broken up. In many instances it becomes necessary to put the weight of a man on the beam in order to make the plow enter the hard ground. A strong piece of plank is bolted to the underside of the beam, on which a man can stand. The plank also serves to prevent the plow from plunging down too deep in a soft place. By having a spar of wood bolted erect to the side of the beam, a person can ride a plow-beam without danger and with little fatigue. Where there are but few stones to obstruct a plow, a ditch can be sunk rapidly with such an implement.

Fig. 17.

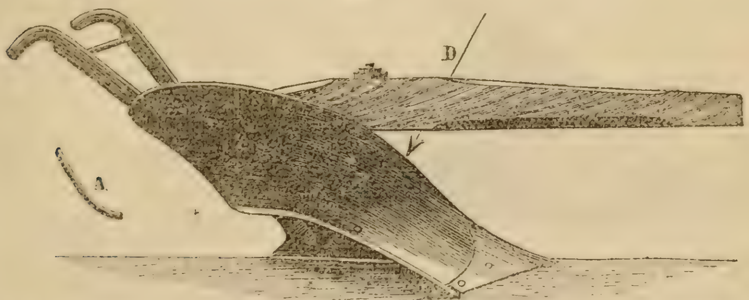


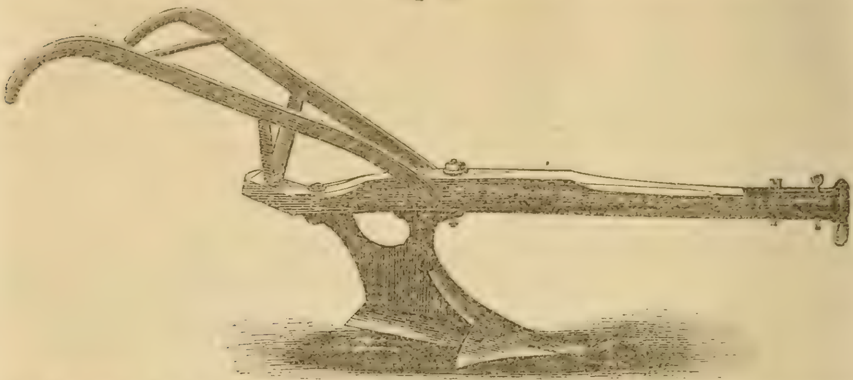
Figure 17 represents the Iowa deep-trench plow, which is so constructed that the entire furrow slice rises and slides up the inclined mold-board almost as high as the lower side of the beam before it is turned over. By driving twice or thrice in a furrow where it is desirable to make a ditch, if the substratum is not too stubborn and strong, such a plow will open a ditch thirty inches deep, which will only require a small amount of manual labor to grade the bottom for a course of tiles.

These plows are very large, strong, and heavy, weighing three or four hundred pounds. Three or four yokes of strong, heavy oxen are required to draw one satisfactorily. No part can be broken by any fair means. A gauge-wheel should be employed beneath the beam until the implement is required to enter its full depth, when the wheel may be removed and the plank-shoe substituted. Where there are many large boulders, or much hard-pan, such a plow would require more teams than could be made to draw advantageously in a line without much previous training.

The subsoil plow proper, (Fig. 18,) is employed extensively, in sinking deep ditches, simply to turn up and pulverize the hard substratum in the bottom of a ditch, so that the earth may be thrown out with shovels. The standard consists of a plate of cast-iron nearly one inch thick, of the form shown by the cut. The share or point is made strong, so that it cannot be easily broken. The light-colored portion above the share

represents a "throat-piece," which is subject to severe wear, and which can be easily renewed at an expense of a few cents. On the side of the standard a flange or kind of shelf is shown, which assists in elevating and pulverizing the subsoil. When such a

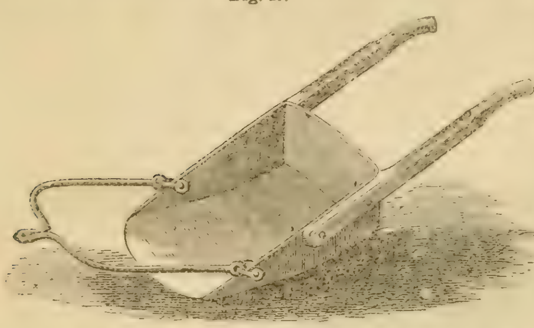
Fig. 18.



plow is drawn in a deep ditch, a chain from three to six feet long extends from the end of the beam to the whiffletree. If oxen are employed, the draught-chain is lengthened at pleasure.

A cast-iron ditching scraper.—Figure 19 represents a cast-iron scraper, or "ox-shovel," employed in excavating large ditches. It is provided with an iron bail, as shown, in lieu of a log-chain, which is frequently used. Such scrapers are comparatively light and strong, and are made of various sizes. The inside should be kept as bright as the mold-board of a plow. When not in use, the surface should be washed clean and covered with a little linseed or cotton-seed oil, or with fresh tallow, to prevent rusting. When a log-chain is employed instead of a bail, a wooden stretcher should be used to hold the chain apart, so that the earth will slide more easily into the implement.

Fig. 19.



Gearing a team to work near a ditch.—After a ditch is about a foot deep, a horse or a mule, if possessed of much spirit, will be afraid to travel near the bank. It is a good practice to provide a double whiffletree, eight feet long from the center of one single whiffletree to the other. Then a light "jockey-stick," or coupling-bar, about seven feet long, is tied between the bits of the two horses to hold their heads the desired distance apart. A piece of pine, basswood, or any other light wood, one and a quarter inches square midway between the ends, tapered to three-quarters of an inch square at the ends, will be found about the right dimensions. By this arrangement, two horses or two mules attached to a plow may each travel more than three feet from the bank of a deep ditch. A person leads one horse carefully at the proper distance from the bank of the ditch. The other horse is kept in his correct place by means of the coupling-pole. If oxen are employed, procure a stick of yellow willow, basswood, or white-wood, six inches square; bore the holes for the bows as for a yoke, and dress out a saddle at each end to fit the necks of the oxen. Great care should be exercised in turning a team around, and in crossing a ditch, that the animals do not step so closely to the edge of the bank that it will cave in. By using a chain of two, three, or four feet in length, between the double whiffletree and the plow, a good team will move along steadily, without pulling or hauling through fear, thus enabling a plowman to turn up the compact earth in the bottom of a three-foot ditch faster than ten men can dig it up with picks. As the depth of the ditch increases, the chain between the plow and whiffletrees must be lengthened.

How to make large open drains.—The most economical way to make a large open drain is to do almost all the excavating with a plow and dirt-scraper. For example, stake out a section, say thirty or forty rods long, and with a plow mark out a land twelve

to sixteen feet in width, according to the proposed depth of the drain, and plow that strip deep, turning the furrow-slices outward, or each way from the point where the center of the drain is to be. If there is no sod on the surface, let this strip be plowed over and over again, working the dirt outward at every plowing. One man with a team and a good plow will move more earth than two men with a team and scraper, until the depression is two feet in depth; then hitch the team to a good dirt scraper, and scrape the dirt each way from the center of the middle furrow. There will be more or less depression perhaps a rod from the middle furrow, which should be leveled up with the dirt that is scraped out. Continue to plow and scrape the earth each way until a valley three feet in depth is excavated, having a smooth slope clear down to the lowest point. Such a ditch will never cave in. Besides this, the land can be seeded with grass-seed, and the grass be mowed with hand scythes, or with a horse-mower, clear down to the water. Two and one-half or three feet deep will furnish a satisfactory outlet in most instances for branch drains. After the valley is excavated as directed, cut a water-channel with the plow and ditching tools about six or eight inches in depth, and from one to two feet wide, according to the amount of water that will probably flow when the stream is at an ordinary height. The reader will be surprised to see what a long line of open drain two faithful laborers, with a team, plow, scraper, and hand-tools will be able to make in a day, when they operate as above directed.

Let it not be understood that such a drain as the foregoing is recommended where all the water can be carried in an underdrain of large capacity. There are places on many farms where the stream of water is so large during most of the time in late autumn, winter, and spring, that an underdrain, fifteen or twenty inches square, would be inadequate to the volume of water. In such instances the proprietor must resort to an open drain.

In many instances the open drain may be made on a straight line between two fields or plots of ground, rather than in the natural channel of the water. The writer has frequently turned small streams from their natural course through the middle of cultivated fields, by excavating such an open drain as has been suggested along the margin of tillable land. In the natural channel of the water-course an underdrain was made, so that the low ground, which had always been inundated with "flood-water" at certain seasons of the year, was never overflowed. By adopting such a system of drainage, the open drain will appear at the margin of a field where it will cause less inconvenience than if it were to be made in the middle. By sinking a channel, as directed, all the silt from the side drains, and the wash from the slopes, will be collected and not be carried beyond the farm. Every autumn the channel should be cleaned out, as more or less grass will have sprung up during the summer to obstruct the water.

Brooks of considerable magnitude frequently flow through a farm, winding and doubling over a large area of choice ground. By excavating such a ditch as we have indicated, one can frequently save nearly enough choice land to defray the expenses incurred in its excavation. The proper time to make such an open drain is during the summer, when there is very little or no water. In case there should be some water, keep the middle furrow clean, so that the stream will not spread and wet the dirt that is to be scraped out.

Making outlets of drains.—Many an excellent underdrain has been seriously damaged in consequence of a poor outlet. When the outlets are made of stones, the influence of the freezing and thawing of the ground, and the tread of heavy animals, will frequently displace many of the stones, so that the passage soon becomes obstructed. If tiles are employed, one or two are sometimes broken, or they disintegrate after having been frozen and thawed a few times. It is a common occurrence to see a pond of water several inches deep at the outlet of a drain, with the water-course six inches below the surface of the water. Such drains are liable to be obstructed in one or two years. The outlet of every drain, especially of main drains, should be made with much care. If stones are employed, a good outlet may be made by using a covering-stone two or three feet long. Otherwise it will be advisable to make a wooden outlet, as illustrated by Figure 20, which is made by first placing a board or plank on the bottom of the ditch, if the ground is soft, then by setting a strip four inches wide on each side and covering with short pieces, as shown by the cut. A board is frequently laid on lengthwise, which is objectionable, as the covering will not be so strong as if the same board were cut in pieces and laid crosswise.

Fig. 20.

The water-channel beyond the outlet should always be kept clear of mud and gravel, so that the water will flow away rapidly from the drain. If a pond is desirable for collecting water for stock to drink, let an excavation be made at a short distance from the outlet of the drain, so that the water may wash out all the fine earth that may be accumulated in the water-course of the drain.

How to make a convenient watering sluice.—Figure 21 represents the mode which the writer employed to construct watering sluices in those fields where all the water had been collected in underdrains. A gorge eight or ten feet wide was excavated with plow and scraper directly across a deep drain, and a plank box without bottom or top, eight or ten feet long, was set from bank to bank as represented. A hole in the end-plank permitted the water to enter the box, and a similar orifice allowed it to escape through the other end. By this arrangement sheep and swine, as well as horses, mules, and cattle, could step down to the sluice and drink at pleasure. The water should be four or five inches deep in the box, and the inclined excavation should be paved with stones, so that heavy animals may not poach up the ground, and thus make a deep mud hole. The surface of the pavement should be as low as the surface of the water. Such sluices should be constructed when deep drains are made, if water for domestic animals is an object. The holes in the sides of the box, through which sheep and swine may put their heads, should not be made so large that small animals may get into the water.

Filling ditches with flat stones.—Where there are no cobble-stones to place on the sides of a ditch, but a liberal supply of flat stones, the ditches may be dug as narrow for a small drain as can be excavated to a depth of thirty inches. Then, if only a small water-course is required, stones may be set on the edge against each side, and a third stone be dropped in between the two side-stones, like the key-stone of an arch, as represented by Figure 22. Large flat stones may then be broken into small pieces, and the cavities filled with them, the surface being leveled up, earth-tight. A drain filled properly with flat stones placed in such a manner will render excellent service as long as water continues to flow, provided the outlet is kept clear from all obstructions.

Another mode of filling a ditch with flat stones is shown by Figure 23, in which is shown a water-course of a much larger capacity than is represented by the preceding illustration, (Fig. 22.) We will assume that a ditch is ten inches wide on the bottom. A course of thin stones is set on one side, as shown, another stone is set on one edge in the opposite corner, and the top inclined against the side of the other stone. The surface is then leveled up properly with suitable fragments. The operator should have a good stone hammer which he can handle with one hand, to dress off the edges of stones, and to break large pieces to fragments of a desirable size.

When a water-course of a large capacity is desirable, flat stones may be set on edge on both sides and a flat stone, dressed off with the stone-hammer, be fitted to rest firmly on the upper edge. Great care should be exercised, however, when flat stones are employed in this manner, to see that the covering stones rest on the side stones with sufficient weight to keep them from falling over into the middle of the water-course. Thin and scaly pieces should not be employed for covering stones except over the joints of strong pieces which cannot be crushed by the superincumbent pressure of the earth.

Careless boys and heedless men, who possess no mechanical skill and who care little whether a drain operates satisfactorily or not, should never be permitted to place the side stones and covering stones in a ditch. They may aid in leveling up and in finishing the stoning, but some careful and intelligent person should be employed to place the side stones and covering stones. One or two stones carelessly placed will cause great damage to a drain.

A convenient guard-board.—When laborers are distributing stones along the bank of a ditch, many of the stones will rebound and roll into the ditch, where they are not wanted, thus making much disagreeable labor in removing them. To prevent stones from falling into the channel, employ a stiff board placed on one edge at one side of the excavation, which allows the stones to accumulate in a ridge close to the ditch without rolling into the channel. Two sticks, one near each end of the board, hold it on the edge. One end of each stick enters a hole through the board, while the other rests against the opposite bank of the ditch. Such a board may be twelve or sixteen feet long, and it should not be less than one foot wide. In case stones are distributed before the ditch is made, the guard-board will aid materially in keeping the stones in a close ridge.

Filling ditches with irregular stones.—When small boulders of almost every shape and size are to be employed, great care should be exercised to leave no passage for the water except the interstices between the stones. In laying a row of stones on each side of a ditch, the operator should exercise judgment in selecting those of a uniform size, as nearly as may be, so that the covering stones may rest on every side stone on both sides of the ditch, to prevent rolling toward the middle of the channel. When necessary to use side stones it is necessary to use several of that size, placed side by side, rather than to lay a few small ones between the large ones, which will often be one or two inches below the covering stones.

How to place the side stones.—The operator lays one of the stones in the desired place, and supports it with one foot while he lays the covering stone in its place, which tends to hold the side stones firmly against the walls of the ditch. The entire superincumbent pressure is upon a narrow space near the corner of the ditch. By this

PLATE XXXIII.

Fig. 21

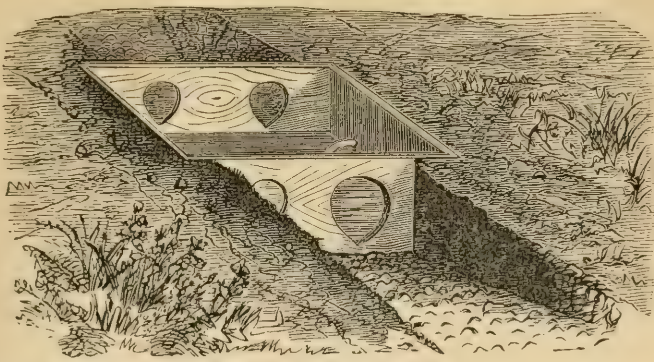


Fig. 22

Fig. 23

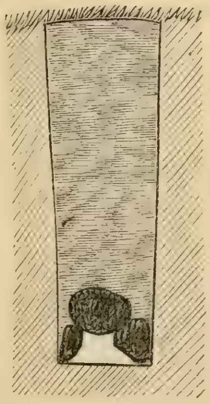


Fig. 24

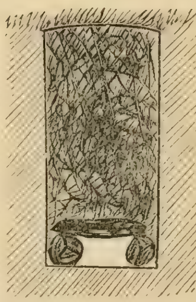


Fig. 25

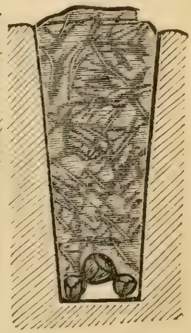


Fig. 26

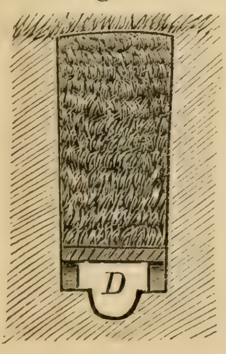


Fig. 27

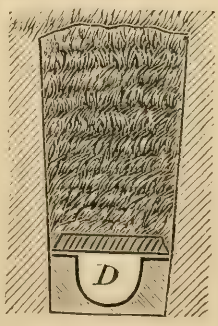
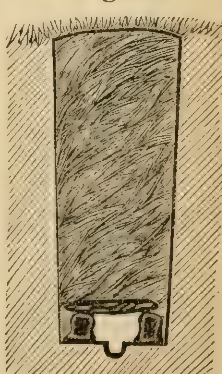


Fig. 28



METHODS OF FILLING DITCHES.

manner of placing the stones the water cannot undermine them; neither can a stream wash out a passage behind them. In case the stream should wash away the earth to such an extent that the side stones must settle, more or less, they will still retain the desired position, and continue to drop directly downward, the covering stone holding them just as they were originally placed. After the covering stone is laid, every large cavity should be filled with smaller stones, and the surface be leveled off with numerous small stones all laid with care, so that the earth cannot work down into the water-course. A great many small stones, not larger than hens' eggs, should be employed to fill the interstices, so that the water-course may not be obstructed, as otherwise the passage for water is very liable to be completely clogged with earth.

Filling ditches with poles and flat stones.—In the year 1843 a large open ditch was filled by laying round poles on each side and covering them with flat stones, as represented by Fig. 24. Flat stones were scarce, and could not be obtained within a distance of three miles. The poles were chiefly white and red beech, laid in the ditch the same day they were cut, and were usually about four to five inches in diameter. The bottom of the ditch was about fourteen inches wide. All the joints between the stones were covered with thin, small pieces of flat stones. That drain has never, up to the present time, failed to deliver a large stream of water, and to drain the soil thoroughly on each side of it. It was not expected that those green poles would last ten years. If such perishable timber as white beech will last in a ditch twenty-seven years, surely cedar and other *durable* timber will endure a life-time. Poles will last much longer if the timber be thoroughly seasoned before being laid in the ground. If small boulders, or even hard-burned bricks, could be substituted for poles, they would be far preferable to wood.

Filling ditches with rails or poles.—This mode of filling ditches is noticed chiefly to point out the defect incident to the use of such materials for making a water-course. Fig. 25 represents a ditch filled with poles, one being laid in each corner of the ditch, with a third covering the space between the two. On account of the want of uniformity in size and shape of the poles, it is difficult to make a satisfactory water-course, unless the pieces are first sawed into short lengths of two or three feet. It will always be found difficult to make the top poles or rails fit down to the surface of the side poles sufficiently close to prevent mice from hauling the earth into the water-course. Unless the poles are unusually straight and of uniform size, there will be a large opening every few feet through which loose earth will fall and soon obstruct the water. If one pole be large and another small, it will be quite impracticable to put on a cover "dirt tight," unless the covering pieces are first sawed of suitable length to be laid crosswise. By preparing the covering in this manner, rails or poles can be advantageously employed. Rails of durable timber may be sawed up, say ten inches long, and laid crosswise on the side rails, thus filling a ditch in a very economical manner where timber is cheap. If poles are employed, let them be sawed of the desired length, then split in two equal parts, and thoroughly seasoned before being laid, and it will be found that timber will render excellent service for an age.

Slabs from timber-logs sometimes make an excellent covering in wood drains. They should first be sawed of the desired length, the edges cut off straight, so that the pieces will make dirt-tight joints, and after they are seasoned the pieces are used for filling ditches. The bark side is always laid up. If the bark does not peel off readily, the pieces should be laid in the ditch with the bark on. Some men of extensive experience contend that timber, when buried a foot or more beneath the surface of the ground, will be more durable if the bark is not removed.

Filling ditches with planks.—In many localities suitable stones cannot be obtained for filling a large ditch, except at a distance of several miles, and at a much greater expense than most tillers of the soil are willing to incur, while durable timber may be so abundant that planks will constitute the cheapest material which can be employed for making the water-course. The writer once made one in this way: The ditches were cut ten inches wide at the bottom, and the corners were dressed out true and square, so that a piece of scantling would fit closely without falling over toward the middle. After the bottom was well graded, a channel, as represented by D, (Fig. 26,) was cut in the bottom about five inches deep by four or five inches wide. After the channel was formed, pieces of scantling two inches square, or two by three inches, were laid in the corners of the ditch, and pieces of plank ten inches long were laid on these side-pieces. In some instances side-pieces two by four inches were employed. The object of the channel in the middle of the ditch is to keep the stream of water midway between the side-pieces, and thus prevent the stream from undermining the sides; also to increase the capacity of the drain. The side-pieces will sustain the planks and keep the channel open, even if the water were to wash away the earth; but by directing the water, at the outset, in a channel, the banks will soon be smoothed over, so that the earth will not wash away, except in sandy soils. Many hundred rods were made by simply laying the pieces of plank directly on the banks of the channel in the bottom of the ditch, as represented by Figure 27. Yet, planks were never laid on

the banks of the channel where the ground was so soft that it could be readily spaded. For drains of ordinary size, the bottoms of ditches were dressed only eight inches wide and the channel was excavated about five inches deep. By this arrangement an excellent ditch was made at the cheapest possible rate. One great advantage in the use of planks laid crosswise, in filling ditches, is the effectual exclusion of mice.

How to prepare the planks.—For ditches ten inches wide, our practice has been to saw the planks into pieces ten inches long. When the pieces were placed in the ditch, the ends fitted so neatly to the side walls that even mellow earth could not be washed into the channel. For sawing the planks, a common circular horse-saw, driven by a two-horse railway power, was employed—the machine used for sawing fire-wood—with which a man, aided by a boy, could saw a thousand feet of planks in one hour. Planks of any width and of available lengths were worked up in the most economical manner. The pieces were assorted before they were laid in the ditch, as one poor piece of plank in the middle of a long drain will cause an obstruction in a few years, as one bad shingle will make a leaky roof when almost every square foot of surface is made of the best of shingles. Any kind of durable timber may be employed for filling ditches in the foregoing manner. Before the pieces are laid in the ditch, the timber should be thoroughly seasoned, and, if the pieces could be dipped into boiling coal-tar after they are seasoned, they would not decay for a hundred years.

The writer employed hemlock to fill several miles of ditch; and every lineal rod of it has rendered excellent service for the last twenty years, showing but little decay. One drain filled with planks has sent out a large stream of water for more than thirty years. It is impossible to keep the water out of such a ditch, if the planks be laid as close together as the pieces can be placed. The water will percolate down past the ends, and flow into the channel.

Filling ditches with oak timber.—In certain localities in Ohio, where stones were scarce, and tiles could not be obtained, and where white oak was abundant and cheap, many tillers of the soil have filled their ditches with split timber. Some of the trees were sawed into cuts about four feet long, or eight feet if the timber would split easily, after which the logs were split into billets about three or four inches square, according to the capacity of the drain. Other trees were sawed into cuts, some eight inches, some ten, and others twelve inches long, all of which were riven into slabs about two inches thick, which were employed for covering, placed from one billet to the other, across the ditch. In case there was but little water, only one billet was laid on one side of the bottom of the ditch, and the covering pieces were laid with one end on the billet, and the other end on the bottom of the ditch. If thoroughly seasoned before it is buried in a ditch, oak timber will endure a life-time. If near a good market, it would be more economical to sell oak timber and to purchase tiles.

Objections to stone drains.—Unless stone drains are made three to four feet deep, and great pains taken to fill all the interstices with small stones covered with hard dirt, so that mice, rats, frogs, and other animals cannot work through and haul the earth down into the channel, the water-course is liable to be obstructed in many places. In many instances, a stream of water flowing on the surface of the ground, along or across a stone underdrain, will almost always form a large hole down to the stones, and wash the channel full of earth. One instance may be referred to, of a large stone drain that was made forty-five years ago, no part of which has ever failed, although the ditch was sunk only two feet in depth. The stones were laid with much care, and the surface was so neatly chinked with small stones that mice could not work through. We have also known stone drains made in a careless manner, which did not operate satisfactorily for two years, as the surface was not properly chinked with small stones.

Comparative cost of stones and tiles.—When the writer first commenced underdraining with stones, he learned that he was obliged to work faithfully and to move quickly to gather and distribute stones enough along a ditch in one day of ten hours, to stone ten lineal rods of ditch. Common laborers, when employed by the day, would not accomplish so much as that. Then, on an average, he could stone one rod per hour, and do it well. Some "jobbing ditchers" professed to stone twenty to forty rods in a day; but the depressions and interstices and holes would not be well filled with small stones. No value was placed on the stones; and the labor of the team was of no account, as the horses would require no more feed to perform that little labor than if they were idle. Hence there were the wages of one man three days to stone twenty rods of ditch, computed at $6. It would require for twenty rods about two hundred and eighty-two tiles fourteen inches long. At 1¼ cents each for two-inch tiles, the expense would be about $3 52, besides the laying, which one man would easily perform in an hour. This shows a difference in favor of the two-inch tiles of about $2 48 in twenty rods, or about 12 cents per lineal rod, even where stones cost nothing except the labor of gathering. When four-inch tiles were employed, which cost, when delivered, about 4 cents each, there was a marked difference in favor of the stones. Hence it was concluded to be most economical to employ stones if they could be obtained on the farm, if not needed for other purposes, when drains were required of a larger capacity than a two-inch tile. If stones are abundant, and *must* be removed from the field, employ them to fill

ditches rather than purchase tiles and cart stones off the field, to be deposited in large heaps.

Covering the tiles and stones in a ditch.—Straw, hay, and sods have been unwisely recommended as a covering for tiles and stones. A more unsuitable material than sods cannot be employed, especially for covering the stones in a ditch. Sods will decay in a few months, and thus cover the stones with a mellow mold, which will be constantly working into the water-course of the drain. Mice like no better earth to work in than decayed sods. Straw, also, will soon decay, and the fine material will be washed into the water channel, and thus obstruct the passage. All such material as straw, sods, and the surface soil or mold, should never be placed in contact with the stones or planks of a drain. On the contrary, the heaviest and most compact earth or sub-soil should be returned first to the tiles or stones. As soon as the tiles are laid, some careful man should cover them by carefully shoveling over them a few inches in depth of the heaviest soil, after which the earth may be returned with a plow, on a team attached to a dirt-scraper. There will usually be more or less stone among the earth that was drawn out of the ditch; and, if great care is not exercised in returning the first few inches in depth, stones will crush the tiles in numerous places.

The writer once directed the laborer to lay the tiles in a ditch and return the earth, and to *cover the tiles first by shoveling in earth with extreme care.* The drain failed to dry the land. Upon digging down the tiles were found full of standing water. A large portion of the drain had to be taken up and relaid. In five different places small stones had been allowed to fall on the tiles, crushing them to such an extent as to obstruct the flow of the water. A small stone, half as large as a man's fist, if allowed to fall on a tile at the bottom of a three-foot ditch, will crush it. Consequently, this part of the filling should be performed with great care. If by accident a stone breaks a tile, a sound one should be substituted at once. One thousand tiles may be laid well, and covered in the best manner, and yet if only one near the outlet be crushed by a stone the entire drain will be of little value.

The most expeditious way to return the dirt after the tiles have been covered is to hitch two horses to a plow having an evener eight or nine feet in length. The heads of the horses should be held apart at the proper distance by a jockey-stick, about eight feet long, as suggested on a preceding page. Another economical way is to employ a dirt-scraper, to which the team is hitched by a chain six to ten feet long, according to the width of a ditch. Then, let one person drive, hauling the scraper to the bank of the ditch, and stopping the team just in time to allow the scraper to be dumped without being drawn across the ditch. Two men, with a team and scraper, will haul in dirt more rapidly than twenty laborers will cast it in with shovels. We have frequently read the recommendation to lead a horse lengthwise of the ditch, as the earth is being shoveled in, for the purpose of treading it down firmly. It is an unwise practice, as there is great danger of injuring the animal, and still more danger that his feet will damage the water-course.

Ditching-machines.—We have not yet met with a really successful and reliable power ditching-machine, one that will excavate the desired depth through "hard-pan" and such stubborn land as is frequently found on the slopes of rivers and lakes. There are many power-machines for ditching, which will operate very satisfactorily on any kind of ground, where there are no small boulders as large as a man's fist, and where the substratum can be spaded; but when a machine is started in ground where there are some small stones, and occasional bars of hard-pan, a hand-digger is required with a complete set of tools to excavate certain parts, which cannot be done by a power ditcher.

Tiles and stones together.—Fig. 28 represents a mode of filling a large ditch, which has frequently been employed with satisfactory results, where a drain of large capacity was desirable. If flat stones can be readily obtained, say one foot in width, excavate the ditch about fourteen inches wide on the bottom, dressed out at the corners, so that tiles will fit closely at each side. Before the tiles are laid, a channel should be scooped out in the middle, as represented, that the stream may not undermine the tiles. Then lay a course of tiles on each side, and place flat stones carefully on the top, as shown by the cut. It is important that the top stones be laid on with care, and neatly leveled up, with thin pieces on the under side. The joints of the covering stones should be fitted closely and covered with small thin pieces, to prevent mice from hauling earth into the main water-course. In case the stones should be more expensive than another course of tiles, it would be preferable to lay three, or even four courses of tiles, side by side. When large tiles could not be obtained readily, we have sometimes laid three or four courses of small tiles in the bottom of a ditch, thus forming a water-course fully equal to the capacity of the stream when the water was at its greatest height.

Laying tiles on boards.—It is the practice of many tillers of the soil to lay a narrow board in the bottom of the ditch on which the tiles are placed. This is more particularly the practice when horse-shoe tiles are employed. It is not a commendable practice to place timber of any kind beneath tiles, as some portions of boards will almost always decay in a few years. If proper care is exercised in selecting sound pieces, and scru-

pulously rejecting every cull, a drain will endure much longer than when all qualities of lumber are employed. If horse-shoe tiles are employed, they should be placed on plates, or soles of burnt clay. Soles of burnt clay will cost but a trifle more than lumber. We would not recommend soles, however, nor horse-shoe tiles, if pipe tiles or sole tiles can be procured.

The correct way to lay tiles.—Some writers on the subject of underdraining recommend the practice of laying tiles on the bottom of a ditch while standing on the bank. For this purpose they recommend the use of a "tile-layer," with a long handle like that of a pitch-fork. The hooked rod is thrust into the bore of a tile, with which the latter is let down to the bottom of the ditch and placed as nearly in its position as a tile can be. If every tile were quite true and straight, and the bottom of the ditch were as smooth and true as a newly-finished pavement, tiles could be laid in this way. It must be remembered, however, that almost every tile is a little crooked, or twisted, or warped, and that it is almost impossible, in many places, where the ground is full of small stones and large gravel, to make the bottom of a ditch true and smooth. Consequently, if the operator lays the tiles while standing on the bank of the ditch, the form of some of them will frequently be such that the ends will not match satisfactorily. Hence, the only correct way to lay tiles of any kind is for the operator to stand in the ditch, and place each tile in the best possible position. In case a joint is too open at the upper side of the tiles, try another tile. In many instances a tile will rock, as the middle rests on a bar of hard earth or a small stone, in which case the prominence should be rammed down, so that the tile will not rock. Sometimes the digger finds it necessary to remove a small boulder from the bottom of the ditch, thus leaving a depression one or two inches deep. All such cavities should be rammed full of hard earth before the tiles are laid, so that the end of one section may not be forced down by the superincumbent pressure so far that the caliber of the two adjoining tiles will not correspond. Placing tiles in the bottom of a ditch is a piece of labor to be performed but once during a life-time; hence, the importance of laying *every one* with the utmost carefulness. It is far better to take the time to lay every tile properly than to hurry them in at random, which may necessitate the redigging and reconstruction of a portion of the drain. When ditches are unusually deep and very narrow, and the bottom consists of earth free from stones, so that a true channel can be formed for the tiles, they may be laid with the tile-layer.

Silt-wells in drains.—It is an excellent plan to construct silt-wells in several places in main drains, as they facilitate observation as to the flow of the water, and provide effectual means for collecting the fine silt that is washed into the drain by the constant influx of water, especially when the soil is thoroughly saturated. They also furnish an outlet for mice, frogs, &c., which frequently enter the water-course if they have access to drains.

Silt-wells should be made when the ditch is dug. Such wells are to a drain what a man-hole is to a street sewer in a city. An excavation should be made across and in the bottom of a ditch about two feet square and at least one foot deeper than the bottom of the ditch; then a curb of planks, bricks, or flat stones set on end may be employed. The water discharges into the well and flows away by entering the tiles on the opposite side. The silt washed along in the tiles is deposited in the well, which, when filled up as high as the tiles, should be cleaned out. A curb made of planks of durable timber will endure a great many years.

RECLAMATION OF MARSH LANDS.

The subject of the reclamation of marsh lands is one which must claim the attention of the country in the immediate future, as agricultural lands advance in price and population increases. A few instances of successful reclamation upon the Atlantic and Pacific coasts have been reported in the publications of this Department.

An elaborate communication from Mr. Jerome J. Collins, civil engineer, of Hudson City, New Jersey, gives at length an account of the reclamations accomplished in other countries, and in the vicinity of New York City, with a statement of the principles upon which such work is properly conducted and the obstacles to be overcome in its prosecution.

He also gives an exposition of his theory of the formation of tidal marshes, and medical views concerning malaria or miasma and the adaptability of marsh lands for cultivation, which are not subjects suited to the original and practical character of our reports. The following extracts are given:

A GLANCE AT THE HISTORY OF RECLAMATION.

If we glance back over the many centuries the brave inhabitants of the Netherlands have held their fertile country against the ocean, after rescuing it from the waters, we must be struck with admiration at such an instance of a nation's perseverance. The Hollanders found their country a morass; they now present it a very picture of fertility and abundance, and we must not forget that, though they worked hard at their national defenses against the ocean, they were not spared the horrors of war by their neighbors. The country they strove to rescue from the sea became, on account of its position, the battle-field on which many European quarrels were decided, and the inhabitants were often compelled to cast aside the spade and grasp the sword in defense of their lives and property.

The periodical overflowing of the Nile to uncertain limits necessitated the controlling of the waters within defined boundaries, and this control was most undoubtedly exercised by means of embankments.

The Phœnicians—the people of Tyre and the ancient sea-ports of the East, the Greeks and the Romans erected extensive works on their sea-coast to protect their cities and ships from ocean storms and foreign enemies, and no doubt they inclosed low-lying lands in many instances for the purpose. The Romans during their occupation of Britain raised immense lines of embankments at several points along the coast, the remains of which are still in existence. In fact, all nations as they advanced in civilization seem to have recognized in reclamation a means of extending the area of land to be distributed among the people without necessitating an emigration of surplus population.

This has been the case in India and China, where the dense population manages to accommodate itself to the limits of those countries, and it is only within the last few years that we have seen any signs of a movement by these people to other countries.

The original settlers of the Netherlands were the descendants of those wandering tribes whose emergence from their homes in the North heralded the downfall of the Roman empire and laid the foundation of the nationalities which at present checker the map of Europe.

The first steps toward erecting barriers against the tidal overflow in Holland are stated to have been taken in or about the second century of the Christian era. It is probable that vanguards of the great army of invasion which in later times overran Europe from the north had begun to move forward and occupy in small bodies the country lying along the northern coast. As the population increased and the groups of mud huts grew into large towns and cities, the necessity for placing under cultivation more extensive areas of land became imperative. The more valuable these settlements grew to the people, the more desirous were they to guard them against destruction by the sea, and the attention of the government and people was directed to the general and permanent embanking of the whole coast. How they have succeeded we all know. The country which was once a desolate marsh is now a garden. Visitors passing through it acknowledge that in no part of the world is scientific agriculture better understood or applied, although the fields and dwellings are in many places twenty feet below the level of the sea. It was not alone necessary to embank against the sea, but also against the waters of some of the great rivers whose sources are to be found in the very heart of Europe, and which would overflow all the low lands they traverse had not the precaution of confining them to their natural channels been taken by the Hollanders.

Many works have been written which give detailed descriptions of the manner in which the diking of the Netherlands was carried on. The foundation of the work was laid by nature. The superstructure is the work of man. Along the coast exposed to the northwestern storms a bank of sand was washed up by the action of the waves, and a natural barrier was erected against the incursion of the tidal waves. A belt of wood which grew along the coast, and against which the sand was heaped, assisted the early toilers in their labors by affording both shelter and material. This wood has since disappeared to a great extent in the constant repairs rendered necessary by the action of the waves in stormy weather.

Beyond strengthening and connecting these mounds or banks of sand, and securing the lands in the immediate neighborhood of the ocean from tidal overflow, little was done in the beginning on the main embankment along the coast, while the river banks were left wholly exposed. The great work once initiated, however, it has pro-

gressed steadily to the present day, and we find that after a struggle lasting many centuries the energy and perseverance of man have wrested a kingdom from the sea.

Writers on the subject of the early condition of Holland tell us that the country was covered with lakes, varying in size, which have been drained and converted into fruitful farms. The most important operation lately and successfully completed is the draining of the Haarlem Lake, which covered an area of about 45,000 acres. A description of this work was given in the report of the Department of Agriculture for 1866.

Extensive tracts on the western coast of England, called the Fen country, have been embanked and drained, and added to the cultivable land in that section. As many as 680,000 acres of fen have been reclaimed, and the works rival those of Holland in extent. The Encyclopædia Britannica says:

"This fen country has for centuries been the scene of drainage operations on a stupendous scale. The whole surface of the great basin of the fens is lower than the sea, the level varying from four to sixteen feet below high-water mark in the German Ocean. The difficulty in draining this flat tract is increased from the circumstance that the ground is highest near the shore and falls inward toward the foot of the slope. These inland and lower grounds consist of a spongy peat, which has a natural tendency to retain water. The rivers and streams which flow from the higher inlands discharge upon these level grounds, and originally found their way into the broad and shallow estuary of the wash, obstructed in all directions by bars and sand-banks. These upland waters, being now caught at their point of entrance on the fens, are confined within strong artificial banks, and so guided straight seaward, and are thus restrained from flooding the low grounds, and by their concentration and momentum assist in scouring out the silt from the narrow channel to which they are confined. The tidal waters are at the same time fenced out by sea-banks which are provided at certain intervals with sluice-doors by which the waters escape at ebb tide. When this does not provide such a drainage as to admit of cultivation, the water is lifted mechanically by wind or steam mills into the main aqueducts.

* * * * * *

"In the district called Marsh, in Norfolk, extending between the Ouse and the New, in that called South Holland, in Lincolnshire, stretching between the New and Welland, northward of Spalding, and also northeast of Boston, there are considerable tracts of marine clay soil. In Marshland this is chiefly arable land, producing large crops of wheat and beans, but in Lincolnshire it forms exceedingly fine grazing land. This tract lies within the old Roman embankment by which the district was first defended from the ocean. Outside this barrier are the proper marsh lands, which have been reclaimed in portions at successive periods, and are still intersected in all directions by ranges of banks. The extraordinary feature in this tract is that the surface outside the Roman bank is three or four feet higher than on the inside, and the level of each new inclosure is more elevated than the previous one. The land rises step by step as the coast is approached, so that the most recently reclaimed land is often twelve and sometimes eighteen feet higher than the lowest fen land in the interior, the drainage from which must, nevertheless, be conveyed through these more elevated marshes to the sea."

These extensive works are represented by many hundreds of miles of river embankments, and the sea-coast line embanked exceeds one hundred and thirty in length. This fen land, once, like that of Holland, a wild marshy tract, impassable to man or beast, is now a fertile farm, rich in agricultural products, and inhabited by a healthy and wealthy population.

Another instance of successful reclamation is to be found in England: the Bedford Level, called after the Earl of Bedford, who in the year 1634 expended over £100,000 to reclaim these lands, and whose son completed the work at an additional cost of £300,000. These lands have since that time been kept perfectly free of water by means of windmills and other pumping engines.

Extensive drainage operations have been carried on in many parts of Europe, particularly in France and Italy. The celebrated Pontine marshes, near Rome, are mentioned by early historians as a source of great danger to the public health, and several unsuccessful attempts were made to reclaim them. The popes at different periods renewed these efforts, and their success, though partial, proved that the drainage could be effected with sufficient capital.

In Ireland immense tracts of peat-bog have been drained and converted into arable land. The bog of Allen is an extensive area of peaty soil, extending into several counties, and covering many thousand acres. In the southern part of Ireland, along the rivers and shores of the main estuaries, large areas of alluvial deposits have been inclosed by embankments, and a rich soil made available for cultivation.

The cotton lands in the valley of the Mississippi are exceedingly fertile when properly protected by levees from the periodical overflow of the river. The construction and maintenance of these levees are often the subject of discussion in Congress, and it would seem proper that the nation's representatives should interest themselves in what

forms the only protection to the agricultural interests of several of the States of the Union.

In Canada the question of reclaiming the marsh lands is receiving considerable attention from both the government and the people. Extensive works are about to be commenced, with a view to these reclamations; and vast areas of fertile soil will be added to the lands of the New Dominion.

In this country the question of utilizing marshes has not yet attained the importance it deserves.

In the neighborhood of New York a considerable tract of land, known as the Newark Meadows, lying between the Newark and Paterson range of hills, on the west side, and the Palisade ridge of Bergen Hill on the east side, has been embanked and otherwise drained and reclaimed within the past two years.

WILL RECLAMATION PAY?

A question for consideration is, will reclamation of marsh lands pay those who invest their capital in such undertakings? When we invest our money in that which is perishable, stealable, or depreciable in value to such an extent as to become positively worthless, we have an uncertain security for the principal invested, and profit is doubtful. We can invest in that which is itself a standard of value, such as the gold coinage of the country. In this case the security is good in the thing itself, but the profits are uncertain. Or, investment can be made in that which has an intrinsic value of its own, non-depreciable, independent of any standard value but its own worth, and above all indestructible and immovable, and advancing in value with time, such as good land. For this investment the security is certain, visible, and tangible, and the profits are equally certain, and limited only by the inactivity of the investor in developing them.

As it is the interest of every State to develop its resources, and as the principal source of wealth to a country must be the productions of its soil, it is of the highest importance that these should receive attention. Capitalists will unhesitatingly engage in speculations for the working of distant gold mines, where the chances of profitable return depend almost entirely on the lucky striking of a rich vein of the precious metal, of which we hear of more disappointments than successes. With a plethora of money in our markets, men are continually seeking for safe and profitable modes of employing their idle capital and in lieu of the desired investment they are often content to accept the comparatively small percentage allowed by the banks, while almost at their doors may be found the means by which their capital can be safely and profitably employed in the reclamation of these much-needed marsh lands.

In the case of the Hackensack meadows near Newark, New Jersey, reclaimed by the Iron Dike and Land Reclamation Company of New York, the whole area selected for reclamation was about 4,500 acres, which were purchased by the company at an average price of $50 per acre. The cost of inclosing this area with an embankment, and the cutting of a series of main ditches and drains throughout the whole area, did not exceed $250,000, which would be equal to about $55 per acre, making the cost of purchase and reclamation about $105 per acre. Previous to the commencement of the works, the marsh was completely overflowed at every tide, and the entire embanking and ditching were done by manual labor, while the insertion in the whole length of river embankment of Driggs's patent iron dike plate added considerably to the cost of the works. They have 4,500 acres of wet marsh purchased and reclaimed for $105 per acre. When this land has been thoroughly drained it will be worth $1,000 per acre. If it takes three years' cultivation to bring it to this condition, the tract at the end of that time will be worth, say, $4,500,000. Meantime the land will rent for $50 per acre per annum, which sum is, at the end of three years, equivalent to $675,000 or $200,000 in excess of the original cost.

We have the value, then, at		$4,500,000
Add amount of rent for three years at $50 per acre		675,000
		5,175,000
Cost of land and reclamation	$475,000	
Interest three years, at 7 per cent	99,750	
Cost of maintaining banks, &c., three years	27,000	
		601,750
Profit to original investors in three years		4,573,250

The location of the land near the city of New York has, of course, much influence on its value, and it is not intended to convey the idea that all reclaimed land will be equally valuable, or capable of returning so enormous profits as the Hackensack meadows promise.

The tracts of marsh lying at a distance from the great cities are not less valuable in proportion, because, if their value is not so great when reclaimed, their present value is very much less, being in many cases as low as $5 per acre, while there would be no increase whatever in the expense of reclamation.

Professor Cook, speaking of the marshes lying along the coast of New Jersey and the neighboring States, says: "The value of banked meadows in Salem County, New Jersey, and along the Cohansey Creek and Maurice River, in Cumberland County, ranges from $200 to $500 per acre. Previous to banking, these meadows were comparatively worthless."

If, therefore, almost worthless marshes can be raised in value to $200 per acre by merely banking them against tidal overflow at a very small cost per acre, what may not be the increase in value when these lands are properly reclaimed, and drained and fitted, at a small increase in the cost, for the highest class of cultivation?

Professor Cook also makes the following statement: "The meadows on the Wallkill, the Pequest, the Paulinskill, and the Passaic are rich lands, and comparatively unproductive, though lying in the midst of the finest part of the State. The improvements must be made, and the land brought to the degree of productiveness which the best interests of the State demand. * * * We have between one and two millions of acres of land in southern New Jersey which are comparatively unimproved. Private enterprise is doing much for its development. Millions of dollars have been invested for its improvement within the last fifteen years, and thriving settlements have been formed. These pioneers deserve well of the State, and they should be furnished with every information and facility for pushing forward their improvements."

Considering the high rents paid at present by market gardeners, amounting frequently to $150 per acre per annum, it is quite certain that every acre of marsh land reclaimed within the next twenty years will find willing purchasers or tenants.

On well-drained land, such as we would wish to see made of our marsh lands, a farmer paying an annual rent of $100 per acre would realize fully treble the profits derivable from the cultivation of upland ground, as he is certain to raise crops such as the upland ground, with any quantity of fertilizers, could not produce; and further, the question of expense in working such ground is important in supporting our arguments, as manures and fertilizers are wholly unnecessary, and a series of heavy crops can be raised for thirty years without the soil requiring any stimulant in the shape of manure.

Farmers complain that the most serious item in the expense of farming is the constant renewal of the vitality of the soil by manures. In the case of reclaimed marsh land this expense is saved, as even the soil itself can be used as manure on upland ground with great advantage. The plowing is also attended with more ease. No large boulders are met with to interrupt the work or interfere with the proper tillage of the soil.

We have here, then, an investment for the capitalist which will return him enormous profits; a rich and productive farm for the agriculturist, that will yield him tenfold for his labor; a means of employing the thousands who are daily flocking to our shores from Europe; and last, though not least in importance, a means of providing an abundant supply of fresh, cheap food for the people who are compelled to purchase the diseased meat and stale and unhealthy vegetables and diluted milk which are to be found in our markets. All these advantages lie within our reach, and we should be blind, indeed, to our own interests did we not seize them.

RECLAMATION OF NEWARK (N. J.) MEADOWS.

The following notes, taken from the engineer's field-books, of a test survey on the Hackensack meadows in the spring of 1867, will give a general idea of the kind of soil to be found on the salt marshes along our coasts and tidal river banks, being records of a series of experimental borings into the soil, made to ascertain the nature of the substrata for a depth of from nine to twelve feet. The boring was taken within fifty feet of the water's edge.

The soil in many parts of these marshes was tested, and, with the exception of some difference in the thickness of the various strata, very little difference occurred in the several tests. The only marked variation in the character of the soil that occur is where large cedar stumps are met, either on the surface or some three feet beneath it. The roots of these cedar stumps are invariably sound, while portions exposed to the air soon rot away. The closeness of the soil, and the uniform state of moisture and non-exposure to the air evidently interrupt their decay. In some places the cedar roots showed on the surface, while in many others they were buried deep in the soil. In drainage the water is not removed to a greater depth than five feet, so that the surface mold and marls are dried while the grass peat beneath still holds the moisture to some extent. Drainage without cultivation will not, of course, develop the good qualities of the soil, but the two judiciously combined cannot fail to produce the results most beneficial to agricultural wants.

Even after the surface drainage, regarded as sufficient to insure thorough reclamation from a state of swamp, the surface soil when turned by the plow presents that rich and friable appearance so highly valued by the farmer. The growth of aquatic plants speedily becomes stunted, and a richer vegetation takes their place. Then, with embankments securely constructed, and adequate pumping-power or sluice-way provided, a thorough knowledge of the theory and practice of agriculture will enable the farmer to reap a rich reward for his labors.

An attempt was made about thirty years ago to reclaim the Newark, or more properly the Hackensack, meadows by inclosing them with an embankment, and constructing a number of sluice-ways to carry off the water. Owing to the neglect of the proprietors, these banks were completely destroyed by the musk-rat, which burrowed into and through them, below the level of high water; and the tide, following the excavation, soon demolished the embankment.

The difficulty to be contended with in this work of reclamation was not the pressure of water, the presence of springs, or exposure to heavy waves in stormy weather, or in removing the water from the soil itself. It was simply to prevent the musk-rat and other borers from penetrating the embankment, and admitting the tide-water on the land. Thick embankments will not resist the boring powers of the musk-rats; they have been known to bore through a solid bank in one night for a length of over sixty feet.

Mr. S. B. Driggs, of New Brunswick, New Jersey, invented the "iron dike," or a system of cast-iron plates inserted in the core of the embankment between the levels of high and low water, by which means the bank is made impenetrable to the rats, where penetration would result in the destruction of the bank and the failure of the reclamation. The limits of the operations of the musk-rat, dangerous to the bank, lie between high and low water levels, as these animals will not work below the level of low water for any distance, if at all, and their borings above high water level are easily repaired and comparatively harmless.

The musk-rat begins boring at the lowest point, and penetrates upward in an inclined direction, so that when the tide falls the excavation is self-draining. For this purpose, then, the boring is commenced at about the level of quarter-flood tide, and is always dry on tidal river banks during low water. The iron dike plates used in the reclamation of the Newark meadows were five feet long, eighteen inches wide, and a quarter of an inch thick. The plates were strengthened by ribbings cast on each side, and were connected to each other by clips cast on one perpendicular edge of the plate which held the plain edge of the next plate, and a continuous line or wall of iron plates was thus erected against the rats.

The embankment erected to exclude the tide waters was constructed over this line of iron plating, with an average base of eighteen feet wide, and a height over the marsh surface of five feet. The material of which it was built was excavated from the main ditch which followed the line of embankment and received all the marsh waters through the main internal ditches and lateral drains. A pumping station was established at a suitable point, and one of Gericke's patent turbinate drainage pumps, capable of discharging 12,000 gallons of water per minute, was erected, with steam-engine and boiler complete. Several sluices of various forms were inserted in the main embankment, by which the water on the land was reduced considerably, and to such an extent that it was deemed inexpedient to use the pump. The entire area of the marsh has been intersected by drains of various sizes, which have been connected with the main surrounding drain and with the sluice-ways and pumping station. By these drains the inland water is brought directly to the outlets and the land dried thoroughly wherever the drains are constructed.

Corn, potatoes, cabbages, onions, peas, beans, tomatoes, melons, and tobacco have been grown on these lands, and the corn evidenced the great richness of the soil by the extraordinary growth which it attained. A considerable area of this land is not yet fitted for cultivation, and another portion of it is covered with huge cedar stumps, the remains of a great forest; but the land is very valuable for farming, grazing, and building purposes, and is worth on an average fully $700 to $800 per acre.

The embankments erected around the meadows varied in form as the peculiar wants of the position demanded. As a general rule, the outer slope, or that which received the wash of the tidal wave, was much longer than the interior slope, and the width of the bank on the top varied from three to five feet. The mouths of all tidal creeks were carefully closed, and all connection with the outside water cut off. The complete exclusion of the river water was essential to success in this case, as in all others, and experience shows in a marked manner the value of pumping-power as compared with sluices.

GENERAL PRINCIPLES OF RECLAMATION.

In effecting the reclamation of a tract of marsh land, three distinct objects must be attained before the work can be considered complete. First, the exclusion of all waters having their sources of supply or operating from the outside of the limits of

the marsh land reclaimed. Second, the collection and expulsion, by means of drains, ditches, sluices, and pumps, of all waters lodged on the marsh or having their sources inside its limits. Third, the control of all waters that may afterward accumulate on the marsh from springs, rains, or other causes, so that the danger of drowning the land may be avoided and the cultivation of the soil be uninterrupted. Each of these conditions must exist to insure the harmonious working of the other two: the absence of one is fatal to the usefulness of the others. In case of the first condition, when we undertake to exclude waters having their sources outside the limits of the marsh to be reclaimed, it is necessary to erect a dike; but the shape, size, and mode of construction will be governed by the locality, material, and the amount of resistance the dike must offer to the return of the excluded water. The collection and expulsion of waters accumulated on the marsh from rains, or the interception of that deriving its source from springs within the marsh limits, will depend considerably on area, location, and outfall, as well as on the power and capacity of pumps and other water-engines. The control of the water in the soil and its removal for agricultural purposes will depend on the excellence and completeness of the other works, but will also be affected by climate and the character and treatment of the crops raised. The location of the marsh with respect to high lands is of the utmost importance, as, when adjoining upland, it receives the rain-fall of the hills in addition to its own, and unless precautions are taken to control this irregular addition to its own waters, so that the land shall not suffer from it, the third condition for a complete reclamation cannot be said to be complied with.

Embankments are necessary for the exclusion of water from an area where the source of that water is above the level of the surface to be kept dry. For instance, the embankment of a reservoir must of necessity be above the level of the river, spring, or other reservoir from which the first receives its supply, unless, indeed, the discharge from the latter be equal to that which it uniformly receives, and its embankments lose their retaining character, and become simple diverters of the stream. In like manner, any space inclosed by an embankment for the purpose of excluding water must have that embankment higher than the highest level of the encroaching water, if an inland stream, or the highest known range of the tide, if on a tidal river bank or the sea-coast, unless, in the case of the inland stream, the water becomes simply guided in its course, and not confined.

As our principal marshes requiring embankments are located along the shores of the large bays and inlets, or on the banks of tidal streams, remarks will be confined to such marshes and their requirements. In erecting a dike to resist the pressure of the tide, the shape, the size, and the mode of construction of the dike must vary with the location and the range of the tide. Location affects it because the bank may at one point be sheltered from the eroding action of the waves, while at another point it may be exposed to their full force. It is therefore evident that some dissimilarity must exist between the work to be done by the two sections of the bank, and a consequent difference becomes necessary in their shape, strength, and mode of construction.

Many plans have been projected for the erection of dikes, sea-walls, and embankments, each possessing some peculiar merit, while failing to fulfill equally important requirements. No particular form of dike can be recommended for all cases, as the necessity of each case demands special treatment. The Dutch engineers favor long slopes for sea-banks, constructed of sand or other light material, but the length of the exterior slope can be safely diminished where a durable material, like stone, can be procured, with the additional security of piles and other protection; it is also certain that where the material is not adhesive and durable, long slopes, especially facing the waves, are advantageous, when not exposed to the face of the ocean waves, as on the coast of Holland.

A base of about five to one, divided between the internal and external slopes, in addition to the width of the bank on top, would afford ample base for an embankment. Thus, if we require an embankment six feet high to resist the encroachment of the tide, we cannot with absolute safety construct it with a base of less than thirty-five feet to resist effectually the wash of the waves. This width of base would admit of, in the first place, a width on the top of the embankment of five feet and external slope of three and a half to one, and an internal slope of one and a half to one. The bank with a thirty-five foot base is suited to exposed situations, where wind and wave act directly but moderately. Where the bank is subject to a heavy blow from the waves, the slope will be so graduated as to receive and gradually deaden the effort of the wave as it traverses its surface.

The shape of the bank is of as much importance as its construction and dimensions, because, if by unsuitable proportions we subject the very best material and workmanship to extreme and unnecessary strains, it cannot be expected that the work of resistance will be performed as effectually as if due consideration were given to the relations which should always exist between the shape, material, and amount of resistance the bank is expected to offer to the water. Durable material is not always to be had where wanted for embankments, but in the case of salt marshes, with very few exceptions, the soil excavated forms a superior material for their construction. This is more gen-

erally the case along the shores of large rivers and estuaries, where the silt from the river-bed is continually being washed up against the bank, and during high tides carried over and deposited on the surface of the marsh along the river-banks, forming a compact soil, which, when used in the construction of a bank and dried, becomes hard, durable, and water-tight—the three most important requirements for an embankment.

The fitness of these marsh soils for embankments has been tested, and where used not the least trouble has been experienced with them either by a settlement or breach, but the shape of the bank has been preserved unchanged after severe winters and heavy rain storms.

When banks are erected to exclude water, they must be made perfectly impermeable to that element. The least leakage is but the forerunner of "a burst," unless quickly attended to. These leaks are frequently caused by the imperfect construction of the bank itself, where the material is not packed close, or some of the joints between the sods of soil have not been thoroughly closed by the workmen. Another cause may be the shrinkage of the material when drying in the bank, joints that were close while the moisture swelled the material of the bank being opened by the shrinkage of the soil, and admitting tiny streams, which soon become serious leaks, and finally the cause of the destruction of the bank. Of the two causes, either may be guarded against by proper care in constructing the bank.

There is still another cause of leakage and the failure of a bank—the penetration of the bank by musk-rats and other boring animals, whose attacks must be steadily resisted by constant vigilance and the adoption of some plan of construction which will defeat their operations. Several attempts which have been made at reclamation in this country owe their failure to the musk-rats. These animals are not to be despised as enemies to marsh reclamation. As workers they are unrivaled in perseverance, for they will return again and again to the attack on the same point of an embankment, until they succeed in boring it to their satisfaction, or are killed by a lucky shot. On the Newark meadows, New Jersey, they were defeated effectually by means of the iron plate inserted in the embankment, and covering the space between the range of high and low water. The rats penetrated the bank in many places, but were stopped by the plate, and they either gave up their excavation or cut their way over the plate at a level above that of high water, and the consequent injury to the bank was slight and easily repaired. A core composed of a less expensive material than iron would answer the same purposes, and a well-constructed dike core of wood, hemlock for instance, will probably be found fully equal to all requirements. There are conditions, however, under which the iron core might be preferable.

To accomplish the second important condition, the collection and removal of all waters lying stagnant or otherwise, and having their source of supply within the limits of the marsh, a series of main and intermediate ditches or drains must be cut through the marsh, for the collection and conveyance of these waters to some point or points on the line of the main embankments from which it can be forced out by pumps, or drained out by sluices.

In the case of tide marshes, where the range of the tide brings the low-water level sufficiently below that of the marsh surface to admit of the drainage of the soil to a proper depth, and a fair outfall for the water collected in the ditches, a number of well-placed and properly-constructed sluice-gates will assist considerably in draining the land, as the volume of water drained into the river or bay will be in proportion to the fall and capacity of the sluice to discharge it. Although many advantages are derived from the use of sluices on marsh lands, they are not to be compared in efficiency with a well-constructed pump, worked by steam-power. No matter how well constructed a sluice may be, or of what material, there is always a weakness about it and a liability to accident that must impress itself upon the observer. The connection made between the embankment and the wood-work or masonry of a sluice is, in nine cases out of ten, the site of numerous leaks, which are continuously enlarging and are the more dangerous on account of their apparently trifling character. The material of a sluice may be iron; it corrodes and gets easily clogged by slight obstructions, such as small branches of trees or tufts of grass. If made of wood, it is liable to rot away under water, and be unexpectedly destroyed by a violent storm or other cause. The stone-work setting of a sluice, on account of the alternate wetting and drying process that goes on, particularly during the winter frosts, will work out all the mortar or cement from the joints, and the whole sluice is liable to be undermined by the action of the current passing through the sluice twice in every twenty-four hours. If the sluice is self-acting, it is a source of danger, as it is liable to be obstructed by floating wood, grass, weeds, &c., and is certain to be frozen up in winter time, and in case it should be so prevented from working properly, the sluice being set to low water, the obstruction to the free flow of the water or to the closing of the gate against the rising tide will not be discovered until, in the latter case, the tide begins to flow in through the sluice, when the obstruction is placed out of reach. In this way considerable damage may be done to young crops by an overflow of salt or brackish water. If the sluice is worked by hand, it is equally dangerous, as

neglect will result in a general overflow of the reclaimed land and a probable destruction of valuable property. The best provision that can be made against an overflow from a neglected or defective sluice-gate is the use of pumps exclusively for the drainage of tidal marshes. A considerable saving is also effected by using a pump, as fuel can be economically used and only when required, while the cost of pumping from one station will be much less than sluicing from a dozen points, when a larger staff of workmen is required.

The general plan of the ditches and drains is regulated as much by the location of the outfall as by the actual wants of the land. The object being to remove the water as quickly as possible from the place where it accumulates, and by that means to save every inch of the fall, the ditches should be laid out with that object, and every part of the tract to be drained should be connected with the outfall as directly as possible. It is also desirable to keep a current flowing through the ditches to the outfall as uniformly constant as possible, so that no deposit can occur in the drain to obstruct the passage of the water. This uniformity of motion and direction cannot be obtained by the use of sluices, or rather can be obtained by no other means than by pumping-power, which has no cause for stoppage by reason of the ebb and flow of a tide, the effect of prevailing winds, or any other obstacle to the free and constant flow of water through a sluice-way.

By the use of pumps a uniform and unbroken line of embankment is presented to the outside water, having no weak places to cause a fear for its stability, no wood-work to rot away, iron-work to corrode, or masonry to be destroyed. Complete control is obtained over all accumulations of water that may occur after rain storms; a deeper drainage of the land is possible, as the level of low-water outside does not affect the operation; and in the case of heavy rains due preparation can be made by the engineer to deal with the water, for when the barometer indicates a change of weather or the approach of a storm he can pump his ditches dry if necessary, and keep the water very low during the heaviest rains; on the other hand, the pump need not be worked more than one day in the week during dry weather. When certain conditions favor the adoption of the sluice in preference to the pump, it is wise to adopt that system; there are some cases where no choice can be exercised.

Where springs are found on these marshes, either isolated or in groups, it is proper to connect them with a main drain through a lateral ditch; and when found in groups to surround them with a ditch by which their waters may be removed as fast as discharged, and not permitted to saturate the soil for any distance around.

The removal of water from the soil for agricultural purposes is the last and most important condition to be fulfilled in the work of reclamation. The fitting of soil such as is found on our marsh lands for the reception of suitable crops calls for the exercise of considerable skill on the part of the agriculturist. He finds a virgin soil in the formation of which almost every fertilizing element is employed. His experience of upland farming may be very extensive; but here he has land that requires peculiar treatment, but no manure, no invigoration, to call forth its productiveness; nothing except the ditching tool and the plow, and the farmer's personal care and management, is required to achieve success equal to the highest expectations.

An excess of moisture in a soil hurts vegetation by keeping the temperature of the subsoil low, and weakening the effect on the plants of the various chemical constituents that assist in the development and support of vegetable life. The remedy for this evil must necessarily be drainage. The absence of a proper moisture is equally damaging to vegetation, as many of these chemical constituents of soils are brought into active operation by the water in the soil and the vitality of the plant is thereby sustained. Water is the principal constituent of the sap of plants, and its absence in proper quantity must cause an exhaustion to the vegetable similar to that produced in the animal life by loss of blood. The want of natural moisture is usually supplied artificially by what is known as irrigation. We must seek a mean between the two conditions of excess and total absence of moisture, in order to arrive at that in which a soil is best fitted for the production of a healthy vegetation.

Some soils, owing to their formation, will retain moisture more readily than others, and, therefore, require a different style of cultivation. Sandy soils are dry and represent the opposite extreme to the marsh in point of humidity. This is due to the composition of the soil. Sand, being purely granicular, permits water to pass easily through it until it sinks to the level of some denser substratum. Marsh soil, especially alluvial or vegetable deposit, is absorbent; its particles are so minute as to form a closer and more compact combination not easily penetrated by any foreign matter moved by the force of gravity alone, insoluble, and possessing in a high degree the property of inducing capillary attraction. Nothing but deep incisions into the surface of this soil creates that positive *disconnection* of the mass which is necessary for the liberation of the water held in the soil by the sponge-like substance which enters so largely into its composition.

The low situation of marshes and bogs is not a reason for the presence in excess of moisture in their soils. In many instances these bogs are found on the tops of high

mountains. Tracts of peat bog in various parts of Ireland and England, where the surface is soft and shaking, are as high as eight feet above the level of the adjoining dry and arable land, and the water of these bogs rarely interferes with the dry land in the immediate vicinity, as it is held by the soil of the peat bog by capillary attraction stronger than gravity itself, which latter force asserts itself wherever the particles of soil are incapable of losing their identity by being blended in a general mass. The action of this capillary force on the water in the subsoil and the result in favor of vegetation has already been stated in this article and needs no further explanation.

When an outfall is secured, and a regular system of main drains established, the freeing of the excess of moisture for the purposes of cultivation is accomplished by the smaller drains, which intersect the areas not immediately affected by the main drains. The size and capacity of these sub-drains will of course be suited to the area affected and the degree of humidity of the soil. In some parts of the same marsh tract the soil differs so considerably in its nature as to necessitate a variation in the plan of drainage. The proximity of high lands, woods, springs, or other causes of excessive moisture in the soil, must be taken into consideration and provision be made accordingly, but the general principles by which the detail drainage of the land is affected must be observed.

A general inclination or fall of all minor drains to a main drain is as necessary as the fall of the main drain to the outlet, sluice-way, or pumping station. Where tile drains are laid, a fall of one foot in two hundred is sufficient to carry off the water, but as there are many cases in which drain pipes cannot be employed, it is desirable that, while affecting as much ground as possible by a drain, every advantage should be taken of a good fall on the line of each drain, whether a main or an intermediate drain. Various plans for intermediate drains have been suggested and adopted from time to time. Among them may be mentioned one that is formed by a simple trench, cut with a shoulder to support a covering sod, laid grass down, and covered to the surface with the excavated soil. This drain does not last long, but is an economical form. Another kind of drain is made by leaning the flat tiles bridgewise against one another on top, the apex of the triangle so formed being covered with a thick sod, and the remaining part of the trench filled with broken stone and excavated soil. The tile-and-shoe drain has been used extensively in many parts of England. It is a horse-shoe tile, resting on a flat tile, thereby forming a kind of arched drain, from one to four inches in diameter. This style of drain is not now used so much as the simple circular drain pipes, with collared joints, where such a precaution is necessary to preserve the efficiency of the drain. These drain pipes are of burnt clay, about fourteen inches in length and from one to fourteen inches in diameter.

In very humid soils it is necessary to provide a sufficient number of drains to carry off the water after heavy rains as fast as it soaks into the ground. Experiment will soon establish the proper positions and distances apart for these drains. As it is necessary to the productiveness of a soil that the warm rain-water should penetrate below the line of vegetation, the drains should be laid at such a depth as to be clear of the plow and spade, and the frost and the tap-roots of larger plants. As soils are very rarely broken below eighteen inches from the surface, and roots are known to reach down as far as the soil is rich, while the frost penetrates to an average depth of three feet, it would be safe in districts affected by frost to lay drains four feet under the surface, and in warmer climates at a depth of one foot below the line of cultivation. With a suitable connection between the main and the drains, no soil, no matter how wet it may be, can fail to be reduced to a condition fit for cultivation.

As localities differ widely in their physical features, and various circumstances compel special treatment in almost every case, it is not practicable to designate, beyond the general principles that should govern the construction and arrangement of reclamation works, any form of embankment, drain, sluice, or pump to be adhered to under all circumstances. Locality, prevailing winds, climate, range of tide, strength and velocity of local currents, the nature of the soil and vegetation, all combine to alter the character of the works, and a common standard would be impossible. It may be said of all these that locality is the one on which all the others depend for their importance. We find as we traverse the Atlantic coast of this continent a great many varieties of soil in the marshes. This is owing to the different kinds of vegetation produced on these marshes, or which composed their soil originally, and the rapidity of decomposition of this vegetable material in the soil. With locality, climate varies considerably, and climate regulates the character and growth of plants, their development, their time of maturity and of decay. A natural result of all this influence must be that in localities possessing warm climates the vegetation is more varied, more luxuriant, and consequently enters more largely into the composition of the soil than in places where the climate is less favorable for the development of vegetation. The rapid growth and quick succession of crops must tend to a large annual deposit of vegetable matter on the surface, which, before it becomes thoroughly decayed, is itself a soil, from which other plants spring, and the deposit becoming in this way more rapid than the decay which should convert it into vegetable mold, a soil is formed many degrees less dense

in its structure than that of a place where the climate is colder and the growth of vegetation is slower and less luxuriant.

It has been remarked that spongy, vegetable soils will retain water, when sandy and petreous soils will not, and the work of drainage will be increased in proportion to the quantity of vegetable matter found in the soil. It also occurs that this rapidly-formed soil is less fitted for the construction of water-tight embankments than that of a more gradual deposit, on account of its being more permeable to water, and it is often found necessary, therefore, to reject the soil we propose to reclaim, as a material for the embankment, and use that from another place.

While locality and climate materially affect the manner of reclamation, prevailing winds also exercise an influence by their action on the tidal wave. In exposed situations, the winds exercise this influence to such a degree as to necessitate a complete change in the plan of reclamation, especially on the tidal marshes along the coast and the shores of our rivers. According to the course of the river, against the overflow of which embankments are erected, as well as the direction of the opening by which the waters reach the sea, the wind, at certain seasons, causes a raising of the tide wave above its ordinary level, and of course necessitates higher and stronger embankments to resist it.

Reference is not made to the semi-monthly occurrence of spring tides, but to the powerful effect of strong winds on the surface of water, forcing it in the direction in which it blows. When a strong wind and a spring tide occur at the same time, the tide will be raised over the level of spring tide in proportion to the strength of the wind; and when both meet a heavy freshet after a rain storm, the increased volume of the stream is not unlikely to overflow the banks, and inundate the surrounding country for many miles, doing much damage to property, and sometimes causing loss of life.

In level countries the wind blows in a downward direction at an angle of something over 18° with the horizon. The pressure of the wind is in proportion to its velocity—the former increases as the square of the latter.

The following table of velocities and pressures of the wind is taken from Burnell's Hydraulic Engineering:

Name of wind.	Velocity per second.		Effort per yard square.
	Ft.	*In.*	*Pounds.*
Light breeze, hardly perceptible	1	8	0.04989
Gentle breeze	3	4	0.19756
Light wind	6	8	0.79130
Rather strong wind, best for sailing	18	0	6.06996
Strong wind	33	0	20.06690
Very strong wind	66	0	80.26760
Tempest or storm	70	0	101.62790
Great storm	90	0	146.34430
Hurricane	118	0	260.05670
Hurricane able to tear up trees, &c., &c	150	0	406.51180

An instance of the effect of strong wind on water is mentioned by Franklin. A pond, nine miles wide, and of an average depth of three feet, was acted on by a strong wind, which forced the water from one side so that it was laid bare, and the depth of water on the other side was increased to six feet.

Next to the influence of winds and waves on reclamation works, is the action of currents. Where the shore is concave, it would be imprudent to erect embankments close to the water-line, unless some protection in the shape of masonry or piling be placed against the wearing action of the current; while, on the other hand, when the shore is convex, the embankment may be placed even at the water's edge, as the foreshore will continue to gain in the latter case as it loses in the former.

In like manner, on sea-coast embankments, where the bank is likely to be washed by any of the numerous currents created by the movement of the tides, the greatest caution should be exercised in protecting the works from injury, and the exterior slopes should be strengthened in the best manner to resist the action of the water.

To preserve the embankment against the damaging effects of frost, it is well to cover the face of the exterior and interior slopes with thick sods, cut from the surface of the marsh at the time of the construction of the bank, by which means a protection is afforded to the bank by the covering of grass, and the frost is not permitted to penetrate so deep into the soil composing it.

It is impossible to give, within the limits of an article like this, sufficient information to guide the operation of reclamation through all its stages, but enough has been said to impress on the minds of thinking men the importance of the scheme, its feasibility, and its value to public interests.

The work has been initiated in New Jersey; it is about to be continued in New York, Pennsylvania, Maryland, Delaware, and the distant State of California; and it is probable that, within a few years, we shall see a general reclamation of these plague-breeding swamps throughout the country.

RECENT SCIENTIFIC NOTES.

THE FARM YARD.

Carbolic acid and rinderpest.—Dr. Hope, in a communication to the British Association, stated the result of certain experiments upon cattle with carbolic acid, during the prevalence of rinderpest in 1867. Of about 270 cows under his charge, the majority were attacked by the disease; but by injecting a solution of carbolic acid, either through the mouth or rectum, he was enabled to save 111 of them. The remainder, not so dealt with, died, or had to be slaughtered. For this reason, he argued that the chemical treatment of contagion is much better than the medicinal, both in respect to man and adult animals.

Cooling of brooded eggs.—An inquiry is made of the German Poultry Journal whether eggs brooded upon and allowed to become cold can be hatched; in reply to which it is stated that, from extensive observation, it has been shown that eggs which have remained cold for two days or more may even then be successfully brooded, and that the nearer to the period of the escape of the young, the longer may this cooling last. It is, however, necessary that at least half of the brooding period be passed, as, if eggs are left too long in the first half of the period, especially if this is repeated many times, the embryo will, in almost every instance, die. In the second half of the period the chick is already so far formed that a prolonged cooling is not especially injurious to it. It is also established that eggs thus cooled require a longer time than usual to come to maturity.

Preservation of beet leaves for fodder.—In France beet leaves are used very largely as food for cattle. A difficulty has hitherto existed in reference to this application, on account of the readiness with which the leaves become decomposed, and the impossibility of keeping them fresh for any considerable length of time. We are now informed that this has been overcome by M. Mehay, who subjects the leaves to the action of dilute hydrochloric acid, by means of which, after undergoing a special treatment, they can be stacked away in large quantities and kept indefinitely for future use. The application of the acid employed, so far from injuring these leaves as food, seems to impart to them special alimentary peculiarities, visible in the production of an improved quality of butter. Several veterinary surgeons have certified, as the result of a critical examination of the experiments, that the food gave rise to no disturbance of the digestive system, and that in every respect the new preparation was to be considered a success.

Feeding unbroken grain to hogs.—Dr. Lehmann has already communicated to the Agricultural Association of Saxony the results of some experiments in feeding unbroken grain to hogs, the animal to which the

test was applied being a three-year-old pig, of an English breed, which had previously been fed, for a year and three-quarters, exclusively with rye bran. Four pounds of bran were given to it every twenty-four hours; and on each of the first two days of the experiment an addition was made of one pound of the grains experimented upon, the rations being furnished in only a slightly moist condition. The first of the undigested grains were passed off after the lapse of from twenty-four to twenty-five hours, the last of them appearing at various intervals; as, at the end of sixty-two hours for oats, seventy-two hours for barley, seventy-eight hours for rye, and the same for peas. In reference to the quantity of undigested and unaltered grains found in the excrement, it is stated that in one hundred pounds there appeared unchanged and entire 50.6 of oats, 54.8 of barley 49.8 of rye, and 49.4 of peas. From these results it will be seen that in general only half of the entire grain is used in the process of digestion, and that every one who furnishes food in this manner has to supply twice as much as is actually necessary, at, of course, double the necessary cost. It is, therefore, very evident that a due regard to economy makes it expedient to reduce the food to a condition more or less fine before it is given to such animals.

Feeding nettles to laying hens.—The Vienna Agricultural and Forest Journal states that hens fed in the winter with chopped and boiled nettle leaves, or with the seeds, and kept in a warm place, will continue to lay during the entire winter. The experiment was first suggested by noticing the eagerness with which both domestic and wild fowl devour the nettle leaves and seeds whenever the opportunity is afforded. This proclivity is believed to be the reason why, with the enormous yield of seeds by the nettle, comparatively so few plants are produced. It is stated also that in Denmark the seeds and leaves of the nettle are fed very carefully to horses, after having been collected, dried and ground; three times a week, morning and evening, a handful of this nettle dust is mixed with the oats, in consequence of which the horses are said to become fleshy and sleek, and their hair to grow unusually long, and to assume a silky luster, remarkably beautiful.

PRESERVATION OF MEATS AND FRUITS.

Preserving meat in cans.—A new method of preserving meat in tin cans, which is favorably commented upon, is that of Mr. R. Jones, of London. In this process the meat is first packed in its raw state into tins of any desired size. The lids are then soldered down, the top of each lid having a small tin tube inserted in it, which communicates with the interior of the tin. These tubes are next inserted into the exhauster, which is a receptacle connected with a machine designated a "Torricellian vacuum," an apparatus in which the air is exhausted by the action of water. The tins are then placed in the cooking-bath, and at the proper juncture the vacuum is created and the meat thoroughly cooked, at a temperature varying from 180 to 228 degrees. At this stage another feature of the invention comes into play. The vacuum having been created, a supply of gravy is turned on from a receptacle, and the tins filled with nutritious fluid. The feed-pipes of the tins are then nipped and the cases hermetically sealed. By thus filling the tins with the gravy the difficulty of collapse, which has always hitherto prevented large tins from being used, is obviated, while the whole space of the package is utilized. Testimonials, from captains of ships and others who have used it, are furnished by the inventor, certifying to the excellent quality of the meat. By this improved process overcooking the meat

is prevented, and as now prepared it would seem to merit general approval.

Prepared meat-extracts in Java.—It has been frequently remarked that the best inventions of the western nations have, in nearly every instance, been anticipated by processes long since devised and in use by the Orientals, especially by the natives of China and Japan; and we are assured that the subject of prepared meat-extracts takes its place in this category. We are informed by a recent communication of Dr. Pott that the inhabitants of Java have for many years been in the habit of preparing flesh extracts of various kinds, and especially of beef, fish, and crabs, and that in this form they enter very largely into the internal commerce of the country. The preparation is known by the general name of *petis*, while the particular substance, whether the flesh of oxen, fish, or crabs, is indicated by a special affix. The preparation of the petis appears to be very simple, consisting merely in boiling the raw material and chopping it very fine, and then putting it in a press and forcing out all the juices. This juice is then boiled down, at a moderate temperature, to the consistency of sirup, and kept for use. As a general rule, the preparation is made of such pieces of meat of all the animals used as are not sold before the close of market, a precaution rendered necessary by the heat of the country, and the possibility of obtaining ice to carry the food over until the next day. The substance from which the petis is expressed is also dried and introduced into commerce, but is generally used immediately, while the petis is distributed widely throughout the Indian Archipelago, and can be kept a long time. These preparations have an extremely saline taste, due almost entirely to the concentration of the organic salts originally contained in the expressed juice. The smell is said to be quite agreeable, and the taste very appetizing.

Artificial ice in packing fish.—As might have been expected, the artificial ice machines have been extensively called into play for the manufacture of ice to be used in packing fish. In corroboration of previous statements, it is said to be far more durable than natural ice, the crystals being much more solid and exhibiting less tendency to split into flakes. The estimate has been made that thirty per cent. less of artificial than of natural ice will secure the same preservative effect. One objection to some forms of artificial ice is said to be the opacity of its color; but an inventor announces his discovery of a method by which perfectly transparent ice can be obtained, and for its publication to the world he asks the modest sum of five hundred pounds sterling.

Chinese method of preserving grapes.—Travelers inform us that the Chinese have a method of preserving grapes, so as to have them at their command during the entire year; and a recent author gives us the following account of the method adopted. It consists in cutting a circular piece out of a ripe pumpkin or gourd, making an aperture large enough to admit the hand. The interior is then completely cleaned out, the ripe grapes are placed inside, and the cover replaced and pressed in firmly. The pumpkins are then kept in a cool place, and the grapes will be found to retain their freshness for a very long time. We are told that a very careful selection must be made of the pumpkin, the common field pumpkin, however, being well adapted for the purpose in question.

VEGETABLE PHYSIOLOGY AND PRACTICAL HORTICULTURE.

Rearing grape-vines in pots.—A horticulturist in Stuttgardt has devised an ingenious method of rearing grape-vines in pots so as to ob-

tain grapes with very little trouble in a room or other sheltered place. For this purpose a vigorous, healthy cutting of the late growth of the wood is taken, from three to five feet in length, having at the upper end two fruit buds. The cutting is to be entirely enveloped with moss, and bound with bast, but so as to leave the extremity bearing the fruit buds uncovered. The cutting thus prepared is to be inserted spirally into a sufficiently large flower-pot, leaving the fruit buds projecting above the edge of the pot, which is then to be filled with rich hot-bed earth, well moistened, and placed in the sun behind a window, and kept uniformly moist. The water applied should never be cold, but rather lukewarm, so as to stimulate to the utmost the development of the young roots. When the weather is such that there is no danger from night frosts, the pot may be placed outside the window or against a sunny wall, or even inserted in the ground, in order to secure a more uniform moisture and temperature. When the two fruit buds have produced branches, having bunches of grapes upon them, these shoots are to be trimmed, so that two sound leaves remain over each grape shoot, in order to keep up the circulation of the sap, since without this the grapes would not develop. A single leaf would be sufficient, but two are better, for greater security. An occasional watering with a liquid manure is advisable, in order to stimulate the growth of the plant, although this must be applied with care, since an excess will do more harm than good. In one instance a grape shoot treated in this way produced nine large bunches of fine grapes, although such a number would be rather more than could conveniently be supported by the plant.

Colors from wild plants.—A German writer shows that a great variety of colors and dyes can be readily obtained from common plants found almost everywhere, the method consisting principally in boiling them in water at a high temperature, so as to produce a strong decoction. Thus, for instance, the well-known huckleberry, or blueberry, (*Vaccinium*,) when boiled down, with an addition of a little alum and a solution of copperas, will develop an excellent blue color. The same treatment, with a solution of nut-galls, produces a clean dark-brown tint; while with alum, verdigris, and sal-ammoniac, various shades of purple and red can be obtained. The fruit of the elder, (*Sambucus niger*,) so frequently used for coloring spirituous liquors, will also produce a blue color when treated with alum. The privet, (*Lygustrum vulgare*,) boiled in a solution of salt, will furnish an excellent color; while the overripe berries yield a scarlet-red. The seeds of the common burning-bush, (*Euonymus*,) when treated with sal-ammoniac, produce a beautiful purple-red; while the juice of the currant, pressed out and mixed with a solution of alum, will furnish a bright-red color. The bark treated in the same way produces a brown. Yellow can be obtained from the bark of the apple tree, the box, the ash, the buckthorn, the poplar, elm, &c., when boiled in water and treated with alum. A lively green is furnished by the broom-corn, (*Spartium scoparium*;) and brownish-green by the *Genista*.

The ailantus tree.—The disagreeable smell of the ailantus tree while in blossom need be no objection to the planting of it on a large scale as a timber tree, since, as is well known, it is diœcious, and the male tree alone possesses the unpleasant peculiarity. It is only necessary to propagate the female tree, therefore, in order to have an equally fine grove without the practical inconvenience referred to. It so happened that on the first introduction of the tree into this country the male tree alone was propagated. The female, however, is coming more rapidly

into use, and may readily be known by the clusters of seeds it bears, similar to those of some species of the ash family. There are few trees more valuable for timber than the ailantus. The wood has much of the same properties as the chestnut, and is equally durable, grows with as great rapidity, and in its native country obtains a height of between two hundred and three hundred feet. It is said to be well adapted to growth on the western prairies, and will undoubtedly perform an important part in clothing them with forest vegetation.

Propagation of the grape by eyes.—A German agricultural journal informs us that the grape-vine can be propagated by means of eyes, so as to save three years' time in the growth, each eye furnishing a new shoot. Each grape-vine will furnish as many shoots as it has sound eyes, and they are to be cut off about a quarter of an inch from the eye on each side, so as to leave a cylinder of wood about half an inch long, with the eye in the center. If prepared in the autumn, these eyes may be put in a cellar in winter. In April they are to be laid down, at a depth of two or three inches, in furrows about six inches apart, and covered with a little manure, watered in dry weather, and the earth about them occasionally loosened.

Cinchona in Java.—According to Professor Hasskarl, the cultivation of cinchona in Java continues to be a success, the weather having been favorable and the growth of the plant perfectly satisfactory. The number of plants obtained from seeds and layers was about one and a half million, principally of the species *C. calisaya;* eight hundred and seventy thousand were transplanted in addition, and over one thousand pounds of the dry bark were sent to Holland in 1869, bringing from thirty-six to fifty-four cents per pound. The total product of 1870 is estimated at eight thousand eight hundred pounds for exportation, besides some hundreds for home use in the island.

Circulation in plants.—In conducting experiments upon the transpiration of fluid by leaves, it is a matter of importance to determine the rapidity of ascent of the fluid. Professor Church suggests for this purpose the use of lithium citrate, a salt easily taken up by plants, and one which can be detected with the greatest readiness by means of the spectroscope. Its advantages consist in its containing an organic acid, and in its not being likely to meet with any obstruction to its passage from the tissues. An experiment has been lately made with this liquid, as suggested, with great success; in one instance the fluid having risen nine inches in thirty minutes, in another five and a half inches in ten minutes. This is thought superior to the use of coloring matters, which have seemed to experience considerable resistance in their passage through the vessels.

Watering plants with hot water.—It has lately been shown, by careful experiment, that sickly potted plants, even some that have almost died, can be greatly benefited, and sometimes, indeed, entirely restored to vigor, by applying to them warm instead of cold water. In certain cases, oleanders which have never bloomed, or which have done so only imperfectly, after being treated with lukewarm water, increasing the temperature gradually from 140° to 170° F., produced the most magnificent luxuriance of bloom. Similar results occurred with an old plant of *Hoya;* and also with an India-rubber tree which had nearly withered away. In all these cases the application of water heated to about 110° F., without any other precaution, caused a new and flourishing growth.

Giant marmont potato.—A potato known as the Giant Marmont is

much praised by late German writers, as occupying the very first rank among potatoes, in consequence of various excellent peculiarities. A single tuber is said to have produced a weight of twenty pounds.

CHEMICAL NOTES.

Improvement in refining sugar.—A much-needed improvement has lately been made by Dr. Seyforth, of the Brunswick sugar refinery, in regard to the purification of sirups and molasses, in the manufacture especially of sugar from the beet. As is well known, the juices and liquors employed in the first extraction of beet sugar from the raw material, as well as the sirups resulting from the sugar-refining process, generally contain a certain quantity of alkaline substances. By treating the saccharine juices with milk of lime, several of the bases of the alkaline salts present in the juices are separated from the acids they were at first combined with, and by thus being set free, and remaining mixed with the sugar, impede crystallization. One part of alkaline matter can absorb as much as four parts of sugar, and some kinds of molasses contain as much as 8 per cent. of alkali.

Various means have been used to remedy this defect; among them, more particularly sulphuric and phosphoric acids, the use of which, however, is in most instances unadvisable, for various reasons. Sulphurous acid has also been recommended, and used with excellent advantage.

The method of Dr. Seyforth consists in introducing the sulphurous acid either in the form of gas, or as a weak active solution, into the vacuum-pans. In this way it becomes possible to bring all particles of the sugar solution (or sirup) into contact with the sulphurous acid, and to eliminate, by the joint action of heat and vacuum, any excess of that acid which, however, not only saturates free alkalies and carbonate of lime, but also sets free from those combinations the organic acids which may be present, as alkaline salts. The sulphurous acid thus takes hold of the bases they were combined with, while the greater part of the organic acids are volatilized along with the steam. Thus the sulphurous acid promotes the good and ready crystallization of the sugar, while its action as a decolorizer comes also into play. The details of the new process embrace the two operations of the manufacture of the acid in a simple form and its introduction into the vacuum pans. The quantity to be applied in any solution varies from 4 to 8, or from 10 to 15 per cent. of the bulk of liquid sirup to be evaporated. The process is said to involve very little cost, to require no inconveniently large space, to be applicable to any existing manufactory, and to be very easily understood by manufacturers.

Analysis of the ash of the potato.—A careful analysis has lately been made by Dr. Schoras of the ash resulting from the burning of potatoes, this amounting to from 3 to 4 per cent. of the dried potato. According to this chemist, the proportion of potash amounts to over 50 per cent., 45 per cent. being the smallest quantity observed. Of soda there is generally from 2 to 3 per cent.; in most cases only 1 per cent. being appreciable. Next to the potash, magnesia enters as the principal constituent among the bases; nevertheless amounting to only the tenth part of the proportion of potash. Lime is a subordinate element, in most cases scarcely equaling half the amount of magnesia. The percentage of potash was found to increase or diminish as the yield of the crop was large or small; but of the other bases little difference

was found in this respect. It was also observed that the percentage of phosphoric acid increased as that of potash diminished; so that in the abundant harvests it is proportionally less than in the scanty ones, varying from 10 to nearly 18 per cent. The proportion of sulphuric acid is tolerably constant, varying from 5 to 6 per cent. The percentage of chlorine varied very much; namely, from 2 to nearly 8 per cent. The quantitative difference in the percentage of chlorine in the ashes was found throughout to have a direct relationship to the amount of the crop itself. Should this inference, which the author now presents as provisional only, be substantiated by the further experiments he proposes to make, it may be considered that the combinations of chlorine have the same significance in the cultivation of the potato, that gypsum has to various other cultivated plants.

Constituents of the milk of different animals.—From a late examination of different kinds of milk, with reference to their solid constituents, it has been ascertained that asses' milk is most diluted, containing scarcely 9 per cent. of solid matter. Next comes human milk, with somewhat over 11 per cent., while mares' milk contains 17 per cent. The average is seen in the milk of the goat and of the cow. In reference to the percentage of caseine and albumen, human milk is poorest, containing only 4 per cent. of caseine; cows' milk nearly 5 per cent., with more than ½ per cent. of albumen. Again, goats' milk, with nearly 6 per cent. of caseine and albumen, as far as known, has a larger amount of albumen than that of any other mammal. The smallest quantity of butter is found in asses' milk; that of the goat contains the largest, or nearly 7 per cent. Sheep, milk is most nutritious, as it contains 11¼ per cent. of proteine matters and hydrocarbons; and while the milk of the cow contains only about 4 per cent. of milk sugar, that of the mare has 8 per cent., which renders it very prone to alcoholic fermentation, and has given rise to its employment by the Tartars in the production of an intoxicating liquor, known as quass.

FERTILIZERS.

Sulphate of magnesia as a manure.—The accumulation of sulphate of magnesia, or epsom salts, as a waste product at a mineral-water establishment in Königsberg, where it is offered for sale at about 15 cents per hundred-weight, has suggested its use for agricultural purposes, as its constituents enter largely into the composition of most vegetable substances. Magnesia especially is found in considerable quantity in the seeds of various cultivated plants, and especially in corn, &c. The experiment has already been tried of applying the sulphate of magnesia to one part of the field, and the sulphate of lime, or gypsum, to the other; and, according to Professor Goltz, it is stated that, in the case of clover especially, the difference in favor of the magnesia was very marked, although the general nature of its agency appears to be quite similar to that of the gypsum. Both seem particularly valuable in this connection, on account of entering directly into the composition of the plant instead of requiring a certain transformation before being taken up. The sulphate of magnesia, as stated by Professor Goltz, has perhaps a still more important application in the stable, acting like gypsum in retarding the decomposition of the manure, and fixing the ammonia developed from it. The sulphate of magnesia, however, acts more quickly and energetically than gypsum, in consequence of being very soluble in water; just the contrary being the case with gypsum. From the pre-

ceding considerations, therefore, it is inferred that sulphate of magnesia is quite equal to gypsum as a fertilizer, and decidedly superior for use in stables. From one pound to one and a half pounds per day per head will suffice for the latter object, or from four to five hundred-weight per annum. The cost in the vicinity of Königsberg being less than one-half that of gypsum is an important point in favor of the epsom salts.

Action of potash on fruit trees.—Dr. George B. Wood, in a late communication to the American Philosophical Society, in Philadelphia, presented the result of certain experiments made by him upon the effect of salts of potassa when applied to grain and fruit-producing soils. In his view, the depreciation of the productiveness of apple, peach, and quince orchards is due to the exhaustion of potash from the soil. Several such orchards, formerly very valuable, but which had within a few years ceased to bear much fruit, on being treated with an application of wood ashes to the roots of the trees, were completely revived, producing full crops the following year. A still more striking effect was seen the second year, under a renewal of the application. He cited several other instances where the same results followed; in one case where an apple orchard, planted on an old orchard's site, which had never borne fruit, was made to produce a good crop by the application of ashes.

Effect of manure on plants.—A communication, illustrated by diagrams, was lately presented to the Horticultural Society of London, in reference to the effect of manures upon plants in the experimental grounds at Chiswick. As a general rule, plants in unmanured boxes were less vigorous than in those manured; and while purely mineral manures had little effect upon the grasses, they produced a marked improvement in the case of the clovers. Experiments with solutions of ammonia salts and with nitrate of soda showed specific differences in the results in the case of almost all the different species of plants, and it was found that a plant affected favorably by one of these groups of salts was influenced in quite the opposite manner by the other.

Manure from Indian corn.—It is said that a new manure is prepared in France from Indian corn, which is now largely used in French distilleries. The grain, previously coarsely broken, is first subjected to the action of dilute sulphuric acid to convert its starch into sugar. After fermentation the refuse is placed in large tanks, and when all the solid matters have subsided, the clear liquid is drawn off, and the residue yields an excellent manure, containing about 9 per cent. of water, 68 per cent. of organic matters, including nearly 5 per cent. of nitrogen, and about 19 per cent. of mineral matter.

Utilizing fish offal.—An ingenious method, lately proposed, for utilizing the offal of fish, consists in first boiling it with one-tenth of its weight of cheap oil, heating it from 250° to 300°F. It is then treated with sulphide of carbon, whereby the oil naturally contained in the fish, as well as that which was added, is extracted, and a mass is left, quite dry, and containing from 5 to 6 per cent. of nitrogen, and from 12 to 15 per cent. of phosphate of lime.

ECONOMIC SUGGESTIONS.

Vinegar from unripe fruit.—Unripe fruit, especially apples and pears, is much used in the manufacture of vinegar; but the process usually adopted is defective in many important points. We therefore give, for the benefit of our readers, the substance of an article from Graeger's

Manual of Vinegar Making, just published in Germany. The principal fault of the old process consists in throwing away the pulp after the juices are expressed. As this, however, contains a large percentage of starch, excellently adapted for conversion into vinegar, it is necessary to prepare the fruit so as to save this portion of its substance. With this object it is to be grated, exactly as potatoes are prepared in the manufacture of starch, and the pulp passed through a moderately fine sieve, or through a coarse and open-meshed cloth. There is thus nothing left behind but the pomace proper, or cellulose, all the starchy matter having been passed through the sieve with the juice. This is next to be diluted with water in proportion to the quantity of starchy matter thus obtained; and the whole is then placed in a clean copper kettle, 1 or 2 per cent. of concentrated sulphuric acid being added, and heated long enough to transform the starch into grape sugar. The sulphuric acid is to be neutralized by means of carbonate of lime; the gypsum or the sulphate of lime thus produced allowed to settle, and the liquid to become clear, and then poured off. This liquid is to be left for fermentation to take place, either with or without the use of yeast. A liquid having 8 or 10 per cent. of sugar can easily be made to have 4 or 5 per cent. of alcohol after fermentation, which, by its subsequent acidification, will yield vinegar containing 5 to 6 per cent. of acetic acid.

Season for cutting timber.—According to Dr. Hartig, March and April are the most favorable months for cutting timber intended to be used by builders and carpenters, the average per cent. of moisture being less than 47, while in the three following months the average is 48, and in the three winter months, 51. He states that properly-seasoned timber contains from 20 to 25 per cent. of water, and never less than about 10 per cent.; and if the moisture is entirely removed by artificial means the wood loses its elasticity and flexibility and becomes brittle. Any artificial seasoning of wood should be carried on very gradually; the temperature at the beginning being low, and the process not carried too far.

Seasoning of wood.—A writer in an English journal states that small pieces of non-resinous wood can be perfectly seasoned by boiling them four or five hours, the process taking the sap out of the wood, which shrinks nearly one-tenth in the operation. The same writer states that trees felled in full leaf, in June or July, and allowed to lie until every leaf has fallen, will then be nearly dry, as the leaves will not drop of themselves until they have drawn up and exhausted all the sap of the tree. The time required is from a month to six weeks, according to the dryness or wetness of the weather. The floor of a mill laid with poplar so treated, and cut up and put in place in less than a month after the leaves fell, has never shown the slightest shrinkage.

Baobab bark as a new fiber.—It is well known that great efforts are being made over all the world to increase the supply of material for the manufacture of paper and textile fabrics, by calling into play substances previously unthought of in this connection. Among the later additions to the series may be mentioned the fibrous bark of the baobab tree, (*Adansonia digitata.*) This is said to be worth in England from \$70 to \$75 per ton. It furnishes, also, an almost indestructible cordage.

Utilizing the grease of sheep's wool.—An additional instance of the possibility of converting what was formerly considered refuse into valuable material is seen in the case of the fatty matter contained in sheep's wool, and technically known as suint. This contains about 40

per cent. of potassa, and when ignited the alkali becomes entirely mixed thereby with strongly-nitrogenized animal charcoal. The result of recent experiments tends to show that suant, thus treated, may be used with profit in the manufacture of prussiates and cyanides.

Hard cement.—A cement which becomes excessively hard in time may be prepared by mixing two parts of silica, one part of silicate of alumina, and nine or ten parts of carbonate of lime, all in powder, and then roasting in a puddling furnace. The remaining mass is then to be ground and again roasted with two or three parts of carbonate of baryta. In practice, very pure sand will answer for the silica, and chalk for the carbonate of lime, the remaining ingredient being supplied by mineral witherite or natural carbonate of baryta.

Petroleum in dry-rot.—According to Herbst, petroleum may be applied with good advantage in the extirpation of the dry-rot, it being only necessary to paint with the petroleum the surface of wood thus affected. A solution of carbolic acid, however, answers the same purpose and involves much less danger from fire.

Destruction of grain by insects.—Some idea of the injury caused by insects to agricultural products may be formed from the statement that, in one instance, from seventy-four tons of Spanish wheat stored in a granary, ten hundred-weight of beetles were screened out, and in another thirty-five hundred-weight were removed from one hundred and forty-five tons of American corn. The offender in both cases was a weevil, known as *Colandra orisæ.*

Calomel a poison for mice.—A preparation of one part calomel, five parts of wheat flour, one part of sugar, and one-tenth of a part of ultramarine, mixed together in fine powder and placed in a dish, is said to be a most efficient poison for mice.

Glyconin.—A mixture of five parts of glycerine and four parts of the yelk of egg, under the name of glyconin, has been used to some advantage for the healing of wounds, the mixture forming a varnish over the skin impenetrable to air and moisture.

Curing dampness in walls.—A Russian preparation for curing moisture in the walls of houses consists in the use of a mixture made by adding two pounds of white resin to a boiling solution of three and three-fourths pounds of green vitriol in one hundred pounds of water. To this are to be added ten pounds of sifted red ocher, or other color, eight pounds of rye meal, and six and a half pounds of linseed oil, and the whole stirred together until it forms a completely homogeneous mass. Two coats of this mixture are to be applied successively, while hot, but only in dry, warm weather.

Preparation of wooden labels for plants.—Wooden labels for plants, to be inserted in the ground, may, it is said, be preserved for an indefinite time by first dipping them in a solution of one part copper vitriol and twenty-four parts water, and subsequently immersing in lime water, or a solution of gypsum.

METEOROLOGY OF 1870.

COMPILED FROM REPORTS OF OBSERVERS OF THE SMITHSONIAN INSTITUTION, MADE THROUGH THE DEPARTMENT OF AGRICULTURE.

Tables exhibiting the highest and lowest range of the thermometer, (with dates prefixed,) the mean temperature, and amount of rain-fall, (including melted snow,) in inches and tenths, for each month, in the several States and Territories, and at the stations named. Also the averages of mean temperature and of rain-fall for several States. Daily observations were made by the observers, generally at 7 a. m. and at 2 and 9 p. m.

State and station.	JANUARY.						FEBRUARY.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MAINE.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Houlton	23	46	14	—22	17.2	7.90	19	50	4	—40	16.7	7.50
Steuben	20	56	14, 31	— 5	27.2	10.64	20	56	4, 14	— 5	23.0	4.45
Orono	23	44	14	—14	22.4	5.62	15, 19	44	4	—15	18.2	4.30
Williamsburg	18	40	14	—12	17.8	5.37	19	43	4	—21	16.7	6.95
West Waterville	3	45	14	— 7	24.8	6.44	15	46	4	—17	20.5	5.70
Gardiner	3, 23, 27	42	14	— 3	25.9	6.13	19	46	5	—10	21.5	5.93
Lisbon	4	50	14	— 8	26.1	5.80	15, 20	49	5	—12	21.9	5.30
Standish	23	51	14	1	27.9	4.98	....	......	....	......	......	......
Norway	23	48	14	—11	23.4	5.50	15, 18	42	5	—14	18.8	6.59
Cornish	23, 27	44	14	— 2	24.9	5.71	15	46	5	— 3	20.3	5.30
Cornishville	23	48	14	— 2	28.8	7.55	18	44	4, 22	— 2	21.3	6.40
Averages	....	......	....	......	24.2	6.51	....	......	....	......	19.9	5.84
NEW HAMPSHIRE.												
Stratford	17	42	14	—12	21.6	4.46	15, 18	38	4	—12	15.4	5.19
Whitefield	17	52	14	—12	22.3	4.53	12	43	4	—12	16.4	2.92
Hanover	17, 23	33	7	— 7	14.4	......	18	31	22	—17	5.8	......
Tamworth	23	50	14	— 9	24.4	8.58	15	52	5	—20	18.2	7.55
Concord	....	......	....	......	......	......	18	47	4	— 5	23.0	3.08
Goffstown Center	27	55	10, 14, 15	10	29.3	4.20	12	46	22, 25	4	23.0	6.01
Averages	....	......	....	......	22.4	5.44	....	......	....	......	16.9	4.95
VERMONT.												
Lunenburg	17, 23	42	14	—12	22.1	4.55	18	44	2	—13	15.1	5.00
North Craftsbury	23	41	14	—18	18.8	4.67	18	40	4	—16	13.2	5.47
Newport	17	42	14	—22	21.1	6.40	18	42	4	—29	15.9	6.70
East Bethel	23	47	14	— 7	25.0	6.71	12	44	5	—13	17.3	4.44
Woodstock	23	49	14	— 4	23.6	6.20	12	43	4, 24	— 9	16.1	5.21
Near St. Albans	17	44	14	—30	21.2	......	18	42	4	—29	15.0	......
West Charlotte	17	47	14	— 8	27.0	2.66	15	49	4	— 6	22.1	4.83
Middlebury	17	52	14	—10	27.0	2.88	18	42	4	— 3	19.7	3.74
Panton	23	44	14	—14	27.9	4.20	18	43	4	— 6	19.1	4.24
Castleton	23	46	14	......	27.2	2.21	18	46	4	— 2	20.2	3.15
Averages	....	......	....	......	24.1	4.50	....	......	....	......	17.4	4.75
MASSACHUSETTS.												
Kingston	27	56	9	13	33.9	6.05	18	54	22, 25	7	28.5	4.00
Topsfield	23	54	9	2	31.1	6.04	12	44	4, 14, 25	4	23.2	5.98
Lawrence	17, 23	55	9	5	30.4	6.98	15	45	4	4	22.4	3.91
Newbury	23	57	9	4	31.6	......	15	50	4	4	25.1	......
Georgetown	23	56	14	9	31.6	8.50	15	46	4	0	23.3	7.89
Boston	23	65	9	12	34.1	......	....	......	....	......	......	......
Milton	23	54	9	9	35.9	5.32	18	54	25	9	27.1	4.64
Cambridge	23	62	9	6	36.0	......	1	53	22	3	27.3	......
North Billerica	2	56	9	4	32.4	......	15, 18	50	7	3	25.5	......
West Newton	23	62	9	4	34.8	......	18	54	2, 25	6	27.6	......
New Bedford	26	51	9	9	35.4	5.96	15	52	22	8	28.7	4.36
Worcester	23	54	9	6	31.4	6.34	18	50	22	3	25.5	3.04
Mendon	17	56	9	2	31.4	6.20	18	52	22	4	23.3	3.95
Lunenburg	23	54	9	4	30.2	8.25	15	49	25	0	23.8	4.25

Meteorology of 1870—Continued.

State and station.	January. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	February. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MASS.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Amherst	23	54	9	5	30.8	5.87	18	55	25	6	25.3	5.25
Richmond	26	48	14	7	29.2	10.45	18	48	25	9	22.3	6.47
Williams College	23	54	9, 14	2	29.4	5.46	12	45	4	— 3	21.9	5.80
Hinsdale	23	48	8	— 8	24.6	7.10	18	48	25	— 8	19.2	6.15
Averages	......	......	......	......	31.9	6.66	......	......	......	......	24.7	5.05
RHODE ISLAND.												
Newport	25	51	9	17	35.9	5.75	15	59	22, 25	11	30.2	5.32
CONNECTICUT.												
Columbia	27, 28	58	9	2	34.4	11.50	7	56	22	6	28.3	7.22
Middletown	2, 17	54	9	4	32.9	5.13	18	56	22	6	27.1	4.86
Colebrook	23	53	9	— 7	27.8	4.73	18	45	22	— 3	21.5	5.41
Brookfield	2	58	9	15	35.7	6.40	18	58	22	8	30.8	7.80
Averages	......	......	......	......	32.7	6.94	......	......	......	......	26.9	6.32
NEW YORK.												
Moriches	26, 27	59	9	12	40.5	5.09	15	55	22	8	34.8	3.61
South Hartford	17	56	14	— 9	29.7	2.30	12, 18	48	4	— 2	22.7	3.73
Fort Edward	17	52	14	— 4	29.8	......	7, 17	50	4	2	25.3	......
Hudson	23	54	14	5	33.2	2.84	......	......	......	......	......	......
Garrison's	23	58	9, 14	11	33.6	5.04	18	57	22	7	28.0	6.78
Throg's Neck	24	56	9	8	32.0	......	15	54	22	10	31.1	......
White Plains	16, 18	60	9	14	35.6	......	12, 15, 20	47	22	11	31.2	......
Cooper Union	23	56	9	15	37.9	5.10	18	52	22	11	30.8	4.47
Columbia College	......	......	......	......	......	......	18	50	21, 22	12	31.0	7.39
Rutger's F. Coll.	13	64	9	14	39.7	4.91	18	60	22	10	34.4	4.27
Flatbush	22	56	10	18	36.8	4.31	15	48	25	13	29.7	4.27
Glasco	24	55	14	7	32.2	4.74	12	47	22	6	26.7	6.84
Newburgh	23	57	14	12	35.3	3.54	18	54	22	8	29.9	4.50
Minaville	17	50	14	— 2	27.1	4.76	18	39	22	— 6	20.1	4.90
Sloansville	17	68	14	8	29.6	......	......	......	......	......	......	......
Cooperstown	17	57	14	— 1	28.0	4.17	18	45	21	— 2	20.3	3.72
Gouverneur	17	49	14	—14	22.5	4.25	17	43	4	—20	17.6	2.73
North Hammond	17	50	14	—14	24.4	5.94	17	45	4	— 6	18.7	3.11
Houseville	17	49	14	—11	24.6	6.49	18	42	11	— 6	18.1	2.87
Leyden	17	47	14	—13	23.1	4.15	18	38	3, 21	— 4	16.4	4.05
Utica	26	53	14	5	31.1	2.98	18	41	25	8	24.7	5.33
South Trenton	17	52	14	— 2	26.1	4.47	18	40	11, 13, 25	2	19.4	2.91
Cazenovia	17	53	14	— 1	28.0	......	18	42	21	3	22.1	......
Oneida	17, 18	56	14	2	29.7	2.39	18	46	13	6	24.2	5.60
Depauville	17	47	14	— 9	24.6	4.95	18	43	4	— 4	19.5	4.42
Oswego	23	57	14	1	30.1	3.28	17	44	21	7	21.3	1.98
Palermo	17	50	14	— 9	27.1	4.30	17	43	4	— 5	20.3	4.10
North Volney	17	50	14	3	28.1	......	17	44	4	— 2	22.4	......
Waterburg	17	54	14	3	28.1	......	17	44	4	— 9	21.9	......
Nichols	17	60	7, 14	9	31.8	......	12	45	23	— 3	24.8	......
Newark Valley	17	57	14	4	31.2	2.20	18	46	23	— 8	23.3	4.90
Himrods	17	53	14	4	28.7	3.19	17	42	4	— 2	22.3	4.50
Rochester, (M)	2	53	14	8	30.4	3.40	17	47	19, 21	6	24.7	3.38
Do....(F)	17	51	14	7	29.4	3.32	17	48	21	2	24.0	2.67
Little Genesee	17	52	9, 14	8	28.3	5.07	17	43	23	—16	21.5	3.98
Suspension Brid'e	17	52	14	7	28.3	......	17	48	21, 22	3	25.0	......
Buffalo	17	51	14	8	29.0	5.94	17	45	21	3	25.0	2.22
Averages	......	......	......	......	30.2	4.19	......	......	......	......	24.4	4.19
NEW JERSEY.												
Paterson	23	55	9	13	34.8	5.01	18	53	22	7	29.5	5.26
Newark	23, 26	57	9	16	36.1	4.73	18	53	22	10	30.7	4.27
New Brunswick	17	61	9	16	37.3	3.15	18	57	21, 22	10	30.5	3.37
Trenton	16	67	9	18	41.0	5.77	18	60	22	12	34.8	3.20

Meteorology of 1870—Continued.

State and station.	January. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	February. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
N. J.—Cont'd.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Rio Grande	13	62	9	17	40.5	3.63	2, 12, 15	52	22	12	34.6	4.48
Moorestown	17	67	9	15	38.3	3.12	18	58	22	9	32.3	2.97
New Germantown	2, 23	56	9	9	33.9	3.90	18	54	22	5	29.2	2.63
Lesser Cross R'ds.	2, 17, 23	58	9	14	36.1	......	18	56	22	9	31.4	......
Haddonfield	17	67	9	18	38.7	3.54	18	59	22	12	33.1	2.22
Newfield	17	68	9	12	40.3	......	18	57	22	5	33.3	......
Greenwich	13, 17, 23	62	9	17	40.7	2.15	18	54	22	12	35.0	3.01
Vineland	17	63	9	12	40.1	3.35	20	58	22	0	33.2	2.88
Averages	......	......	......	......	38.2	3.84	......	......	......	......	32.3	3.43
PENNSYLVANIA.												
Nyees	23	60	9	5	29.8	4.24	18	48	21	—5	22.7	3.67
Hamlinton	23	56	9	9	33.1	4.07	18	52	21, 22	6	27.1	3.98
Dyberry	13, 17, 23	52	9	5	28.9	4.33	18	49	23	—2	26.8	3.75
Fallsington	17, 23	61	9	17	37.0	3.80	18	60	22	10	33.0	2.60
Philadelphia	17	64	9	19	40.5	4.01	18	59	22	13	34.8	2.56
Germantown, (M).	17	65	9	16	33.7	......	18	58	22	7	32.9	......
Do.....(T).	17	64	9	17	39.3	......	18	60	22	12	33.3	5.43
Horsham	23	63	9	16	37.4	3.81	18	56	22	9	31.8	3.35
Plymouth Meet'g.	17	64	9	17	38.0	3.89	18	59	22	10	32.0	2.89
White Hall	2	55	9	10	34.7	......	18	54	22	5	30.6	......
Factoryville	17	56	9	6	31.2	2.88	12, 18	46	23	—2	24.6	4.20
Reading	17	63	9	17	39.4	3.97	18	60	22	10	33.9	5.88
West Chester	23	62	9	14	37.1	3.94	18	58	22	6	31.2	3.89
Parkersburg	26	60	9	18	38.3	4.00	18	52	22	9	31.9	3.55
Ashland	26	55	......	......	35.8	......	18	54	22	1	27.5	7.10
Tamaqua	17	59	8	2	30.8	......	18	53	21	—1	26.4	......
Ephrata	23	64	9	14	41.7	3.30	18	57	22	6	32.3	2.49
Mount Joy	23	58	9	17	38.6	......	13	60	22	12	34.1	......
Harrisburg	23	62	9	16	38.4	9.10	12, 18	55	22	9	34.3	4.12
Carlisle	17	60	9	17	36.3	5.40	16, 17	50	22	7	31.8	4.35
Fountain Dale	23	64	9	13	36.1	4.19	12	51	21	6	31.0	3.50
Tioga	17	58	9	7	30.3	4.05	12, 18	48	21, 23	—10	23.5	3.50
Williamsport	17	55	8	16	35.7	......	18	48	22	6	29.7	......
Lewisburg	2	54	9	10	32.5	4.20	12	48	23	—1	26.8	4.39
Grampian Hills	17	48	9	1	27.2	5.16	17	42	23	—8	22.1	4.54
Johnstown	13	57	9	6	33.2	4.80	17	50	21	0	28.3	5.01
Franklin	17	55	9	2	30.4	7.75	17	49	21, 23	0	25.6	4.07
Pittsburg	......	......	......	......	......	......	17	55	21	4	31.1	3.40
Connellsville	22	60	9	5	34.7	......	17	55	21, 22	0	28.6	......
Brownsville	15, 17, 22, 26	60	8	10	35.9	5.80	17	60	22	0	31.4	1.83
New Castle	17	56	9	1	31.2	5.10	14, 17	45	21	3	27.1	3.20
Beaver	17	56	9	9	36.1	5.80	16	51	21	5	30.4	2.80
Canonsburg	22	62	9	5	34.8	4.62	17	54	21	0	30.2	3.46
Averages	......	......	......	......	35.0	4.80	......	......	......	......	29.7	3.83
DELAWARE.												
Milford	17	70	9	20	44.6	2.20	18	60	22	13	36.4	2.70
MARYLAND.												
Woodlawn	13	62	9	13	38.1	4.10	18	53	22	7	31.9	3.44
Annapolis	13	69	9	16	39.1	3.23	2	56	21, 22	11	37.7	4.52
St. Inigoes	17	70	9	18	43.2	2.45	18	60	22	11	35.8	2.36
Frederick	23	58	9	18	40.1	3.36	17	55	21	13	36.7	3.42
Mount St. Mary's.	23	60	9	13	36.1	3.78	12	52	21	5	30.9	3.70
Averages	......	......	......	......	39.3	3.38	......	......	......	......	34.6	3.49
DIST. OF COLUMBIA.												
Washington	17	57	8	22	40.6	2.45	18	52	21	13	38.9	3.08

Meteorology of 1870—Continued.

State and station.	January.						February.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
VIRGINIA.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Johnsontown	13, 17	66	9	23	45.7	2.60	15	60	21, 22	17	39.7	3.10
Hampton	17	70	9	22	45.8	3.30	18	65	22	16	41.5	3.10
Zuñi Station	17	71	9	22	47.1	3.04	18	68	22	18	42.2	3.27
Surry C. H	17	80	9	24	48.2	6.88	18	73	22	16	42.1	8.93
Comorn	17	72	9	16	42.5	1.71	18	60	21, 22	14	37.1	1.51
Vienna	13	69	9	14	41.0	2.90	17	55	21, 22	8	36.0	2.10
Fairfax C. H	17	70	8	13	38.2	3.70	17	60	22	10	32.5	2.20
Piedmont	23	67	9	13	37.5	2.95	12, 17	54	22	5	34.6	2.80
Piedmont Station	23	70	9	10	36.1	3.30	2	56	22	1	30.7	2.55
Staunton	17	66	8, 9	18	41.5	3.40	26	57	21, 22	11	36.1	2.30
Lexington	23	74	9	13	43.0	4.65	26	70	22	0	40.0	2.21
Lynchburg	17	66	9	18	44.8	......	15	55	21	17	40.4	......
Snowville	23	66	9	6	36.5	7.30	26	66	22	—1	33.9	6.56
Near Wytheville	23, 26	60	9	6	37.3	2.35	2	54	21	5	34.7	3.00
Averages	....	......	....	......	41.8	3.70	....	......	....	......	37.3	3.36
WEST VIRGINIA.												
Weston	15, 22	60	9	6	36.5	......	26	60	19, 22	—1	33.8	......
Cabell C. H	16	60	8	21	39.0	3.00	12, 13	54	21	12	37.0	2.80
NORTH CAROLINA.												
Kenansville	17	80	10	24	53.6	......	27	76	21	22	47.1	......
Goldsboro	17	80	10	22	52.6	3.00	14, 18	71	21	19	46.4	4.60
Warrenton	....	......	....	......	......	......	12	62	21, 22	12	39.8	4.15
Oxford	17	70	9, 10	22	46.7	3.50	12	66	22	17	43.0	4.20
Chapel Hill	22	71	3	28	51.7	......	15	68	20	18	44.0	......
Albemarle	17	74	5	12	43.9	4.51	26	73	21	9	40.9	3.66
Statesville	13, 17	62	5, 9, 10	14	39.5	5.85	26	62	21	8	36.7	2.94
Asheville, (A)	23	65	9	12	41.7	3.50	26	64	21	7	38.8	2.20
Do. (H)	23	66	9	10	41.5	......	26	66	21	4	38.5	......
Averages	....	......	....	......	46.4	4.08	....	......	....	......	41.7	3.63
SOUTH CAROLINA.												
Bluffton	18	78	5	32	56.1	3.70	27	76	21	32	53.8	2.20
Gowdeysville	13	66	10	18	47.1	4.45	26	68	21	16	44.1	4.45
Holland's Store	15, 17	66	10	20	47.2	5.70	26	68	21	16	46.0	6.98
Aiken	17	77	2	23	49.1	2.86	26	70	21	15	46.6	2.77
Averages	....	......	....	......	49.9	4.18	....	......	....	......	47.6	4.10
GEORGIA.												
Berne	17	78	3	24	52.3	......	27	74	21	26	49.5	3.80
Penfield	13, 14, 17	67	9, 10	20	47.0	2.90	26	68	21	14	44.7	3.50
Atlanta	12, 13, 14, 15, 16, 17, 23	63	9, 10	15	45.1	5.31	26	65	21	10	40.4	6.50
Averages	....	......	....	......	48.1	4.11	....	......	....	......	44.9	4.60
ALABAMA.												
Rockville	16	72	9	33	54.0	4.13	14	69	21	15	46.3	4.80
Carlowville	16	74	2, 9	28	50.3	5.05	14	72	21	22	49.1	6.57
Selma	16	73	5, 10	32	53.7	4.55	14	72	21	24	51.9	5.25
Greene Springs	23	71	5	23	48.4	5.00	14	69	21	19	49.5	4.74
Coatopa	16, 24	73	9	23	50.2	6.50	14	72	21	22	50.1	4.40
Fish River	15	72	4	30	......	1.70	14	70	21	30	......	......
Mobile	17	68	5	27	52.7	3.51	12, 13, 15	68	19, 20	25	50.9	3.30
Averages	....	......	....	......	51.5	4.35	....	......	....	......	49.6	4.86

Meteorology of 1870—Continued.

State and station.	JANUARY.						FEBRUARY.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
FLORIDA.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Port Orange	18, 19, 24	76	3	34	61.1	......	15	79	21	34	52.3	......
Jacksonville	17	82	10	32	59.3	1.05	27	80	21	28	55.5	2.25
Pilatka	15, 17	84	5	29	59.6	2.38	27	78	21	30	56.3	5.29
Ocala	19	89	5	22	60.8	1.12	17	79	21, 25	32	......	......
Manatee	14, 17, 21, 22	82	5	42	67.0	3.00	2, 15	78	19, 22	40	61.7	2.20
Averages	....	......	....	......	59.5	1.72	....	......	....	......	56.5	3.25
TEXAS.												
Gilmer	29	70	2	24	49.9	2.58	16	82	20	22	54.5	0.53
Houston	16	80	2	35	54.8	......	15, 16	83	20	34	58.1	......
Palestine	12, 22	76	17	24	51.1	1.70	16	82	20	20	55.0	0.52
Blue Branch	16, 31	74	18	30	53.1	0.90	15, 16, 28	80	20	28	57.5	0.30
Lavaca	25, 26	76	3, 8	38	53.2	4.30	23	88	18	30	57.9	1.00
Clinton	16	80	2	31	55.2	0.80	16	83	18, 20	30	57.7	0.90
Austin	15	76	17	29	51.2	0.64	22	85	20	27	55.4	0.58
Lockhart	22	76	2	30	52.1	......	25, 28	79	20	25	54.7	......
Averages	....	......	....	......	52.6	1.82	....	......	....	......	56.4	0.64
LOUISIANA.												
New Orleans	22	76	2, 5, 9, 10	34	55.0	4.75	28	80	21	29	55.0	2.12
Shreveport	....	......	....	......	......	......	16, 28	76	20	21	53.0	......
MISSISSIPPI.												
Columbus	16	73	9	23	46.4	7.73	14	69	21	20	47.1	3.88
Enterprise	15	78	2, 5, 9	30	53.0	......	1, 14	71	21	24	50.0	......
Marion C. H.	12, 30	78	2, 10	24	50.3	4.10	12	76	21	18	48.8	3.70
Philadelphia	....	......	....	......	......	......	14	70	21	19	49.1	2.50
Grenada	16	70	9	24	43.4	8.75	....	......	....	......	......	......
Brookhaven	....	......	....	......	......	......	15	73	21	24	51.4	1.68
Near Brookhaven.	16	75	5	26	51.0	9.40	14, 15	75	21	25	50.6	1.60
Natchez	16	72	2	27	51.9	7.72	16, 28	73	21	22	47.7	1.67
Averages	....	......	....	......	49.3	7.54	....	......	....	......	49.2	2.51
ARKANSAS.												
Helena	16	72	9, 18, 19	26	45.0	......	15	69	20	14	46.4	......
TENNESSEE.												
Elizabethton	17	72	9	6	41.7	2.65	14	71	21	6	44.5	3.22
Tusculum College	24	63	8	19	42.3	2.10	14	66	21	6	40.3	1.90
Knoxville	17	70	9	12	41.1	3.30	11	67	21	5	39.7	3.60
Lookout Mount'n.	23	66	9	11	43.8	......	12	68	21	5	41.0	......
Austin	16	70	5, 9	12	40.9	8.60	11, 26	66	21	8	41.4	5.15
Clarksville	16, 26	63	9	15	39.8	8.39	14	66	20	7	40.3	3.03
Trenton	16	67	9	19	43.7	5.58	26	67	20	10	43.8	4.41
Memphis	16	71	9	20	41.7	4.96	14	69	20	12	43.1	4.69
Averages	....	......	....	......	41.9	5.08	....	......	....	......	41.8	3.71
KENTUCKY.												
Pine Grove	22, 23, 26, 30	56	9	−2	36.0	9.93	14	57	21	−2	33.7	4.17
Danville	30	64	9	2	41.1	7.29	11, 12	64	21	1	38.7	3.68
Shelby City	26	60	9	0	37.7	8.28	11	63	21	−2	36.5	3.88
Louisville	26	61	9	11	36.8	......	26	61	21	3	36.5	......
Near Louisville	26	60	9	6	36.2	9.30	26	60	21	3	36.2	2.68
Averages	....	......	....	......	37.6	8.70	....	......	....	......	36.3	3.60
OHIO.												
New Lisbon	....	......	....	......	......	......	17	56	21	−3	29.0	3.10
Salem	17	60	9	−2	32.2	6.05	14	46	21	−2	29.3	2.60

Meteorology of 1870—Continued.

State and station.	January. Date.	January. Maximum temperature.	January. Date.	January. Minimum temperature.	January. Mean temperature.	January. Rain and melted snow.	February. Date.	February. Maximum temperature.	February. Date.	February. Minimum temperature.	February. Mean temperature.	February. Rain and melted snow.
OHIO—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Steubenville	17	56	9	5	35.5	5.73	12	51	22	9	32.0	3.51
Painesville	17	54	9	2	29.3	6.50	11	44	21	3	26.4	2.78
Milnersville	17	60	8	10	31.0	3.30	16	53	19	— 4	30.0	......
Cleveland	17	56	9	2	29.4	6.15	11	45	21	4	26.5	1.68
Gallipolis	17	66	9	8	37.6	5.72	14	62	21	3	34.1	3.15
Oberlin	......	......	......	......	......	......	11	43	21	— 2	29.5	......
Kelley's Island	22	46	9	4	29.3	4.95	11	43	21	0	27.7	1.00
Sandusky	12	48	9	3	30.5	7.30	11	45	21	1	25.5	1.22
North Fairfield	15	53	9	— 2	30.7	5.02	11	46	21	— 4	27.7	1.82
Gambier	17	49	......	......	......	......	11	47	21	— 4	28.2	3.00
Westerville	17	50	9	1	31.7	6.05	11, 26	51	21	0	30.9	3.00
Williamsport	20	50	9	6	34.1	13.35	26	56	21	0	32.2	4.04
North Bass Isl'd	22	44	9	3	28.1	5.40	11	45	21	— 2	27.2	1.76
Marion	17, 22	49	9	— 5	28.9	7.28	11, 26	46	21	— 3	27.0	2.06
Hillsboro	16	54	9	0	32.1	6.25	26	54	21	— 2	31.5	3.13
Toledo	17	49	8	3	29.0	4.50	11	48	21	— 4	28.1	1.69
Bowling Green	12	51	9	0	30.5	6.65	11, 15	47	21	— 5	23.3	1.40
Kenton	15	51	9	4	33.8	8.88	12	48	21	— 2	31.5	1.98
Urbana	16	54	9	— 4	29.9	6.66	26	55	21	— 7	29.1	2.07
Bethel	26	55	9	— 3	31.1	7.25	26	55	21	— 3	32.8	3.75
Jacksonburg	15, 17	51	9	2	31.7	6.65	11, 26	56	21	— 4	31.6	2.75
Mt. Auburn Sem.	16	57	9	2	33.4	6.67	14	59	21	— 4	32.6	2.06
Cincinnati, (H)	16	56	9	4	33.2	5.35	14	59	21	0	33.0	1.55
Do. (P)	26	60	9	7	35.4	6.10	11	58	20	7	33.1	2.98
College Hill	26	52	9	— 1	32.3	8.88	14	54	21	— 4	31.4	1.74
Averages	......	......	......	......	31.7	6.53	......	......	......	......	29.9	2.39
MICHIGAN.												
Detroit	......	......	......	......	......	......	11	41	21	— 9	23.6	2.08
Monroe City	12	47	9	0	23.7	3.36	11	48	21	— 7	27.8	0.70
Adrian	22	42	9	— 4	24.7	5.86	11	45	21	—12	22.1	2.48
Alpena	15, 17	36	13	4	23.7	2.52	7, 9	34	22	— 3	20.8	3.00
State Agr'l Coll.	17	46	9	2	25.4	1.93	7	44	21	—13	24.3	1.20
Litchfield	17	44	9	— 4	24.3	3.18	11	47	21	—18	23.3	2.10
Cold Water	12	46	9	— 2	24.7	8.13	11	49	21	—11	25.1	1.09
Grand Rapids, (H)	{ 12, 22 / 31 }	41	{ 8, 9 / 18, 19 }	7	25.0	......	11	48	21	—10	25.5	......
Northport	17	40	18	4	22.2	......	11	40	22	—12	20.4	1.30
Benzonia	30	35	13, 14	3	22.3	......	7	41	22	—12	21.8	......
Homestead	22	38	13, 14	— 2	21.0	......	16	42	22	—16	24.5	......
Pleasanton	22, 28	38	13, 14	— 1	20.5	2.75	11	45	22	—12	19.9	2.85
Muskegon	22	42	18	8	27.7	......	16	48	21	— 2	26.7	0.95
Otsego	12, 22	50	9	12	33.8	......	16, 18	54	21	0	32.0	......
Copper Falls	16	24	18	—13	11.2	8.95	11	38	20	—18	12.1	5.75
Ontonagon	25	32	18	—14	16.2	......	11	40	20, 21	—24	15.1	......
Averages	......	......	......	......	23.1	4.59	......	......	......	......	22.8	2.13
INDIANA.												
Aurora	22	57	9	1	33.1	7.38	11	58	21	2	33.0	2.59
Vevay	16	60	9	5	34.7	7.18	11, 26	58	21	2	34.4	2.47
Mt. Carmel	22	59	9	0	31.5	4.53	11, 14	52	21	0	30.5	2.09
Muncie	22	53	9	— 1	29.5	4.00	26	58	21	— 6	28.7	1.50
Spiceland	12, 16	51	9	— 3	29.7	5.03	11	55	21	— 7	29.7	1.31
Laconia	16	62	9	3	35.4	6.89	11, 26	62	21	— 3	34.5	2.43
Columbia City	11	48	9	— 4	27.6	3.10	10	54	21	— 5	29.8	0.70
Knightstown	16	54	9	— 5	30.1	5.14	11	56	21	—10	29.1	1.28
Indianapolis	12	55	9	1	33.0	3.73	11	58	21	— 8	32.6	1.08
Near La Porte	10	48	9	— 4	25.2	4.20	16, 25	47	20	— 2	23.2	1.35
Rensselaer	11	47	8, 27	0	25.6	3.95	26	52	21	— 9	26.6	1.60
La Fayette	12	56	8, 9	4	29.9	4.70	......	......	......	......	......	......
Merom	12	58	8	6	31.7	4.11	11, 14	62	21	— 3	32.6	1.90
New Harmony	12	58	8	13	35.3	4.35	11, 26	56	21	3	35.4	2.55
Harveysburg	22	58	9	— 2	26.1	4.60	11	56	21	—12	28.4	0.[illegible]
Averages	......	......	......	......	30.5	4.86	......	......	......	......	30.6	1.[illegible]

Meteorology of 1870—Continued.

State and station.	January.						February.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
ILLINOIS.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Chicago	22	46	9, 18	4	27.1	2.37	11	50	20	— 8	30.0	0.86
Near Chicago	16	48	8	2	25.6	......	11	47	20, 21	— 4	23.6	......
Evanston	22	42	8	— 1	25.0	3.25	11	46	20	— 7	26.9	1.25
Marengo	16	45	8, 18	— 7	20.9	2.28	11	45	20	—13	23.3	0.59
Mattoon	10	50	8	2	30.2	1.76	14	51	20	— 6	28.8	0.93
Effingham	12	62	8	6	30.7	5.75	......	......	......	......	......	......
Aurora	11	45	8	— 2	22.3	5.48	26	48	21	—11	24.3	2.45
Louisville	12	62	9	10	33.0	4.90	11, 14	64	20, 21	— 2	31.7	1.30
Golconda	15	68	7, 9	16	39.2	4.50	17	69	21	2	39.5	7.50
Belvidere	16	43	18	— 7	20.9	1.72	11	45	20	—12	23.0	0.78
Sandwich	16	46	18	— 3	23.4	4.45	26	50	21	—12	25.9	1.10
Ottawa	16	54	8	0	27.9	5.29	26	57	20	— 3	29.6	0.70
Decatur	12, 16	56	8	3	27.6	2.85	26	59	20	— 6	28.5	0.95
Pana	12	58	8	5	29.1	2.30	26	61	20	— 4	30.3	0.30
Winnebago	16	42	8, 18	— 8	20.4	2.87	11	47	20	—11	22.3	0.75
Rochelle	16	44	18	— 4	24.1	......	11, 16, 26	47	20	— 9	25.1	......
Wyanet	16	50	18	— 3	25.5	3.30	26	56	20	— 8	26.3	0.70
Tiskilwa	11, 16	48	18	0	25.8	......	26	54	20	— 6	27.5	......
Hennepin, (S)	11	48	18	— 2	26.0	......	26	58	20	— 5	24.0	......
Do. (O)	11, 12	46	18	1	26.7	1.65	26	56	20	— 7	28.4	......
Peoria	16	52	8	4	28.0	2.05	26	63	20	— 7	30.2	0.33
Springfield	11	56	8	2	27.6	......	26	56	20	— 4	29.1	......
Dubois	12	64	18	4	32.9	3.64	14	68	20	0	34.2	1.46
South Pass	12	64	8, 9, 18	12	34.7	......	14	68	20	0	36.1	......
Galesburg	11	50	8, 18	— 2	21.4	0.63	26	63	20	— 8	28.0	0.30
Manchester	22	56	8	0	29.5	1.16	26	67	20	— 9	31.5	0.35
Mt. Sterling	11	54	8	— 2	26.4	......	26	69	20	—10	29.7	0.50
Andalusia	16	50	8, 18	0	26.0	......	26	64	20	— 4	28.0	......
Augusta	5, 11	51	18	— 2	26.9	2.12	26	67	20	— 9	30.8	0.12
Warsaw	11	54	8	— 2	27.3	2.20	26	72	20	— 9	32.3	0.05
Averages	......	......	......	......	27.1	3.02	......	......	......	......	28.6	1.11
WISCONSIN.												
Sturgeon Bay	......	......	......	......	......	......	11	40	21	—15	18.2	2.18
Manitowoc	22	4[illegible]	18	—16	21.5	1.30	11	46	20	—16	23.1	1.65
Plymouth	22	40	18	—11	19.0	2.10	11	43	20	—17	21.0	1.40
Hingham	22	40	18	—10	19.7	......	11	45	20	—11	23.2	......
Milwaukee	17	46	18	— 5	22.7	2.37	11	45	20	—11	24.0	1.32
Appleton	16	42	18	— 2	22.0	......	11	47	20	—14	20.7	0.64
Geneva	22	41	8, 18	— 6	22.0	2.10	11	45	20	—10	23.7	0.40
Waupaca	28	40	13	—14	18.9	......	11	48	21	—18	21.8	......
Embarrass	16, 28	35	9, 18	— [illegible]	16.1	......	11	44	21	—22	17.1	1.35
Rocky Run	16	41	18	—10	19.2	2.0[illegible]	7	42	20, 21	—14	22.2	1.99
Madison	16	40	18	—12	17.8	3.25	11	44	26	—15	20.9	1.35
Edgerton	16	42	8	— 6	22.2	2.65	11	48	20	—10	25.5	2.78
Monroe	16	36	18	—25	11.9	2.31	11	43	20	—20	16.1	0.82
Baraboo	25	36	18	—12	18.7	6.88	26	52	20	—16	22.5	3.25
New Lisbon	28	46	18	—18	17.2	......	10	54	20	—24	22.5	......
Bayfield	3, 29, 30	28	18, 23	—18	9.6	......	11	42	21	—28	13.3	......
Averages	......	......	......	......	18.6	2.77	......	......	......	......	21.0	1.59
MINNESOTA.												
Beaver Bay	15	34	18	—19	11.4	2.67	12	43	21	—26	15.5	2.74
Afton	28	36	21	—21	10.9	2.45	26	44	20	—26	15.1	0.85
St. Paul	5, 28	33	18	—20	14.8	1.34	10, 26	39	20	—23	17.8	0.60
Minneapolis	28	32	18	—30	9.9	2.15	9, 10, 26	36	20	—29	14.9	0.56
Sibley	28	36	23	—20	9.3	1.53	10	39	20	—32	14.6	......
Koniska	28	32	17, 23	—24	10.7	2.05	10	40	20	—30	14.8	0.40
New Ulm	5, 28	32	17	—18	11.0	1.74	11, 16	38	19	—22	15.3	0.17
Madelia	5	[illegible]	23	—23	9.7	2.65	10	43	20	—34	14.0	0.10
White Earth	24, 29	30	27	—30	3.7	......	25	42	19	—32	10.9	1.85
Averages	......	......	......	......	10.2	2.00	......	......	......	......	14.8	0.91

Meteorology of 1870—Continued.

State and station.	JANUARY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	FEBRUARY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
IOWA.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Clinton	11	44	18	— 5	22.1	4.50	15, 26	50	20	—12	23.5	0.50
Waukon	16	40	17	—15	14.4	......	11, 26	40	20	—16	20.1	0.50
Dubuque	16	43	17	— 6	21.2	2.22	26	51	20	— 7	25.3	1.36
Monticello	16	40	8, 17	—10	18.8	1.35	7	61	20	—10	25.2	0.31
Bowen's Prairie	11	54	8, 17	—12	19.9	4.10	25, 26	56	20	—12	24.9	1.50
Fort Madison	11	48	18	— 2	25.6	2.89	26	65	20	— 9	29.7	0.15
Guttenberg	16	42	8	—12	17.3	......	11	46	20	—12	21.2	0.33
Mt. Vernon	16	40	17	— 6	21.1	......	26	48	20	— 9	24.0	......
Iowa City	16	44	8	— 5	22.1	2.30	26	57	20	—10	24.9	0.25
Independence	16	40	8, 17	—11	18.1	1.73	26	49	20	—14	21.9	0.50
Near Independ'ce	16	43	8, 17	—12	17.3	4.57	26	46	20	—18	21.7	0.30
Waterloo	11, 16	38	17	—10	21.0	......	26	50	20	—16	22.7	......
Rockford	16	39	17,18,23	— 7	18.9	......	26	47	20	—16	21.9	......
Iowa Falls	11, 15, 27, 28, 29	38	16	— 8	20.9	1.18	25, 26	48	20	—17	......	0.00
Algona	11, 28	33	17	—13	15.8	1.80	16	45	20	—18	20.0	0.00
West Bend	11	36	17	—18	12.6	2.10	10	42	20	—25	17.1	0.00
Webster City	......	......	......	......			16	50	20	—17	24.6	......
Boonesboro	11	48	8, 17	—10	18.7	6.50	25	50	20	—18	24.6	0.00
Mineral Ridge	11	50	8, 17	— 8	20.5	0.73	10, 25	51	20	—13	26.4	0.01
Fontanelle	10	45	17	—13	21.4	0.68	25	57	20	—14	28.0	0.00
Rolfe	11	40	17	—17	16.5	1.38	......	......	......	......	......	......
Grant City	28	42	8, 9, 17	—12	17.5	1.10	......	......	......	......	......	......
Logan	10	49	17	—11	19.5	0.90	25	60	20	—15	29.6	0.00
Woodbine	10	42	17	—18	18.8	0.29	25	59	19	—14	28.0	0.01
West Union	10, 30	46	17	—19	17.9	1.72	24	52	20	—17	23.4	0.78
Averages	......	......	......	......	19.1	2.21	......	......	......	......	24.0	0.34
MISSOURI.												
St. Louis	12	63	8	8	34.7	2.25	26	64	20	2	36.7	0.33
Allenton	12	64	8	6	32.8	2.31	25	69	20	— 1	35.5	0.59
Hematite	12	69	8	8	35.8	2.60	14	75	20	1	38.2	0.20
Rolla	16	64	17	8	34.5	1.18	14, 25	69	20	2	36.1	1.06
Jefferson City	16	61	17	2	28.0	......	10	64	20	0	34.0	......
Kansas City	......	......	......	......			10	71	20	— 1	38.2	0.00
Bolivar	11,22,29	58	17	4	35.5	0.31	......	......	......	......	......	......
Harrisonville	11	54	17	— 2	30.2	0.50	25	68	20	4	36.9	0.00
St. Joseph	11	56	7, 16, 17, 18	4	29.2	......	10	65	20	3	39.5	......
Oregon	10	55	17	— 8	26.2	1.00	10	60	20	— 9	34.2	0.03
Averages	......	......	......	......	31.9	1.45	......	......	......	......	36.6	0.32
KANSAS.												
Atchison	11	58	8	— 3	27.3	0.50	10	68	20	— 6	33.9	0.00
Leavenworth	29	56	8	— 2	26.3	0.62	10	69	20	— 6	32.8	0.00
Olathe	11	56	17	— 1	28.7	0.70	9	70	19	— 5	34.5	0.00
Paola	11	57	17	1	30.2	0.50	10	68	20	— 2	36.2	0.00
Baxter Springs	16	68	17	6	35.6	0.70	10	74	20	2	41.2	0.60
Lawrence	11, 29	57	8	0	29.4	0.67	10	68	20	— 2	35.4	0.03
Williamsburg	11	56	11	— 3	27.9	......	10	67	20	— 6	34.4	......
Holton	11	60	8, 17	— 4	27.2	0.75	10	66	20	— 5	34.4	0.00
Neosho Falls	25	57	17	— 1	27.3	0.30	9	69	20	— 2	35.2	0.00
Le Roy	29	58	17	0	32.2	0.25	24	69	19	0	40.3	......
State Agr'l Coll	11, 29	58	17	— 3	27.7	0.05	13	69	20	— 3	34.1	0.00
Council Grove	11	62	17	2	30.5	0.50	10	73	20	0	38.3	0.00
Crawfordsville	11, 21	58	8, 17	4	32.3	0.20	10	75	20	— 2	40.8	0.02
Averages	......	......	......	......	29.4	0.48	......	......	......	......	36.3	0.05
NEBRASKA.												
Omaha Agency	29	46	17	—10	21.8	2.50	25	67	19	—14	32.6	0.00
Blair	10	43	8	— 9	20.0	......	25	60	19, 20	—10	29.4	......

Meteorology of 1870—Continued.

State and station.	JANUARY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	FEBRUARY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
NEB.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
De Soto	10	43	17	—14	19.5	0.35	25	57	20	—15	28.7	0.03
Bellevue	10	49	17	— 8	24.1	0.40	25	62	20	— 5	32.5	0.00
Nebraska City	10	54	17	—12	23.5	1.74	25	64	20	— 5	31.3	0.00
Averages	......	......	......	......	21.8	1.25	......	......	......	......	30.9	0.01
UTAH.												
G't Salt Lake City	29, 30	48	17	11	31.7	......	24	53	18	20	39.1	......
Coalville	21	51	18	—30	26.4	......	9	52	17	—13	28.2	......
CALIFORNIA.												
Monterey	31	73	2, 8	35	51.0	1.13	1	70	17	34	52.7	3.80
Chico	30	70	5	26	49.4	2.70	4	70	17	32	51.3	3.70
Watsonville	29, 30	78	16, 17	34	53.8	3.00	9	79	16	33	54.2	3.59
Vacaville	29	68	2	26	46.2	2.92	3	69	25	34	51.7	3.24
Cahto	28, 31	68	5, 6, 9	33	48.0	15.00	3	66	17	32	49.1	9.40
Visalia	31	78	2	21	45.7	0.14	8	78	5	29	51.8	2.76
Clayton	31	75	2	29	46.1	1.52	5	74	25	35	52.0	3.19
Averages	......	......	......	......	48.6	3.77	......	......	......	......	51.8	4.24
MONTANA.												
Deer Lodge City	31	51	18	—36	22.0	0.64	21	55	17	—15	29.4	1.05
COLORADO.												
Denver	31	60	16	— 5	29.4	1.15	24	64	5	1	33.5	1.70
WASHINGTON.												
Port Angeles	2	53	17	25	43.8	10.95	22, 23	50	11, 15	38	45.7	8.70
Walla-Walla	30	64	18	— 2	35.6	4.41	......	......	......	......	......	......
OREGON.												
Portland	28	63	18	17	40.2	4.85	22	58	16, 27, 28	32	42.5	4.30
Eola	28	56	18	16	36.5	4.35	22	54	16	27	39.2	5.63

State and station.	MARCH. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	APRIL. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MAINE.												
Houlton	20	56	12	—18	26.2	5.70	28	72	1	20	45.0	1.70
Steuben	31	51	12	—13	29.9	4.21	9, 26, 29	57	2	30	40.3	6.40
Orono	30	52	12	— 6	27.9	2.11	27	69	16	27	43.5	3.55
Williamsburg	20	48	12	—15	27.3	3.45	28	72	16	26	41.1	4.50
West Waterville	30	50	12	— 7	29.7	3.15	24, 27, 28	70	3, 16	30	46.3	3.80
Gardiner	30	47	12	— 2	28.6	3.22	27	66	1	29	45.3	4.78
Lisbon	31	56	12	3	29.5	2.50	24	72	1	28	44.8	4.90
Norway	30	52	12	0	28.4	4.60	28	78	1	30	44.6	4.75
Cornish	30	51	11	4	28.0	5.15	28	79	1	29	44.6	6.28
Cornishville	30	50	11	7	28.5	4.80	28	80	4	30	45.3	5.30
Averages	......	......	......	......	28.4	3.89	......	......	......	......	44.1	4.59
NEW HAMPSHIRE.												
Stratford	31	54	12	—18	23.7	2.44	27	72	1	25	43.6	2.22
Whitefield	31	55	12	—18	24.3	2.65	28	78	1	20	46.6	1.86
Tamworth	30	50	4	— 4	26.8	4.38	28	79	1	25	44.0	5.99
Concord	29	54	5	9	30.0	3.33	27, 28	76	1	31	46.6	......
Goffstown Center	20	60	11	10	29.8	3.74	28	87	4	30	46.7	5.04
Averages	......	......	......	......	26.9	3.31	......	......	......	......	45.5	3.77

Meteorology of 1870—Continued.

State and station.	MARCH. Date.	MARCH. Maximum temperature.	MARCH. Date.	MARCH. Minimum temperature.	MARCH. Mean temperature.	MARCH. Rain and melted snow.	APRIL. Date.	APRIL. Maximum temperature.	APRIL. Date.	APRIL. Minimum temperature.	APRIL. Mean temperature.	APRIL. Rain and melted snow.
VERMONT.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Lunenburg	31	52	12	—15	23. 9	2. 01	27	68	4	25	43. 3	2. 50
North Craftsbury	20	48	12	—10	21. 9	0. 95	14, 27	68	4	24	42. 1	1. 06
Newport	20, 31	50	12	—18	23. 4	1. 50	14	73	2, 4	30	45. 5	1. 20
East Bethel	30	53	4	— 4	26. 5	1. 39	28	77	1	23	44. 1	3. 00
Woodstock	30	52	4, 6	— 3	23. 7	2. 60	28	74	1	25	42. 0	3. 27
Near St. Albans	30, 31	51	12	—14	23. 7	......	14	71	2	29	46. 2	......
West Charlotte	29, 30	52	11	— 4	29. 2	2. 26	14	75	2, 4	30	47. 4	3. 25
Middlebury	31	51	11	4	26. 8	2. 11	28	73	4	28	47. 7	2. 67
Panton	31	50	4, 11	2	25. 2	2. 67	14	74	4	28	46. 9	3. 50
Castleton	30, 31	51	11	6	27. 2	2. 89	28	75	4	30	47. 2	3. 75
Averages	....	......	....	......	25. 2	2. 04	....	......	....	......	45. 2	2. 80
MASSACHUSETTS.												
Kingston	28	54	6	12	31. 0	4. 77	27	73	3	30	43. 9	6. 07
Topsfield	21, 22	50	4	9	29. 6	4. 64	14	80	1, 3, 4	32	45. 8	5. 84
Lawrence	22, 30	50	12	13	30. 3	5. 72	28	79	4	31	42. 1	7. 44
Newbury	21	55	11	10	30. 8	......	28	86	4	32	46. 5	......
Milton	22	61	4	13	32. 8	3. 07	28	81	3, 4	34	46. 2	6. 34
Cambridge	21, 22	56	4	13	33. 8	......	28	82	3	32	49. 9	......
North Billerica	30	52	6	10	31. 7	......	28	80	3, 4	32	47. 0	......
New Bedford	20, 22	48	4	13	31. 6	3. 16	14	63	3	33	46. 1	5. 95
Worcester	31	47	11	10	29. 3	2. 34	14	75	4	30	47. 2	6. 03
Mendon	21	48	4	12	28. 2	3. 60	28	75	6	30	46. 2	3. 90
Lunenburg	21	54	11	10	30. 4	4. 35	28	81	4	31	47. 1	7. 80
Amherst	31	51	6	7	30. 9	2. 71	14	78	4	35	48. 3	3. 70
Richmond	21	56	15, 25	10	29. 6	7. 64	28	74	4, 12	30	48. 2	8. 40
Williams College	31	50	15	2	26. 3	4. 76	14	77	4	29	47. 9	3. 30
Hinsdale	21	50	11	6	23. 6	5. 90	28	74	4	28	44. 1	3. 79
Averages	....	......	....	......	30. 0	4. 39	....	......	....	......	46. 4	5. 71
RHODE ISLAND.												
Newport	31	50	4	21	33. 2	3. 95	29	59	3, 4	34	46. 8	4. 52
CONNECTICUT.												
Columbia	21	56	4	16	32. 3	7. 58	28	75	3, 4, 5	32	49. 3	4. 63
Middletown	20	54	6	12	29. 3	5. 58	14	80	4, 6	33	49. 2	5. 41
Southington	20, 21	53	....	......	36. 9	......	14	78	4	33	50. 2	5. 61
Colebrook	20	52	11	9	26. 8	......	28	76	3, 4	31	46. 4	4. 92
Brookfield	21, 22	55	3, 4, 17	18	33. 0	3. 50	28	81	8, 9	32	46. 4	3. 30
Averages	....	......	....	......	31. 6	5. 55	....	......	....	......	48. 3	4. 63
NEW YORK.												
Moriches	15, 31	59	6	16	36. 7	4. 14	14	70	4	35	49. 2	4. 24
South Hartford	31	59	15	1	29. 4	3. 58	14	78	4	32	50. 3	1. 85
Fort Edward	30	63	4, 15	6	32. 2	......	28	76	4	30	48. 0	......
Vassar College	31	56	9	5	30. 4	......	14, 15	80	4	30	50. 7	2. 41
Garrison's	31	56	4	15	34. 4	5. 74	14, 28	79	4	32	51. 0	3. 84
Throg's Neck	31	58	17	18	35. 1	......	28	83	4, 5	34	51. 0	......
White Plains	31	60	17	19	33. 5	......	14, 15, 28	75	4	32	49. 8	......
Cooper Union	31	54	4	22	35. 6	4. 17	28	79	4	33	52. 0	5. 61
Columbia College	21	54	3	20	33. 6	2. 29	28	80	4	33	50. 6	5. 60
Rutgers F. Coll	21	60	17	20	37. 1	3. 25	28	86	1	35	53. 8	3. 91
Flatbush	22	51	2	17	32. 7	2. 19	28	81	5	30	50. 1	4. 18
Glasco	31	58	6	12	30. 7	8. 43	24	80	4	35	49. 6	7. 27
Newburg	31	58	6	16	33. 1	3. 40	14	80	4	30	52. 9	3. 12
Minaville	31	52	4	4	25. 5	6. 30	14, 27	75	4	30	47. 6	5. 65
Bannerville	....	......	12, 15	10	31. 7	......	9	83	3	25	46. 1	9. 50
Cooperstown	20	55	15	— 8	25. 0	2. 53	28	78	4, 8, 10	29	47. 0	2. 36
Gouverneur	20	56	11	— 9	24. 9	2. 79	14	73	1, 3, 4, 8	30	45. 7	0. 96
North Hammond	31	50	11, 12	— 4	26. 1	2. 75	23	66	4	24	45. 9	0. 65

Meteorology of 1870—Continued.

State and station.	March.						April.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
N. YORK—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Houseville	31	58	11	— 2	25.7	3.60	14	76	4	26	45.6	1.39
Leyden	31	45	11	2	23.7	4.30	14, 27	68	4	23	45.3	1.75
Utica	30, 31	57	3	8	29.8	4.09	27	80	5, 8	35	49.8	1.36
South Trenton	29	50	15	2	24.1	4.13	24	70	3, 7, 9, 10	30	44.7	2.54
Cazenovia	31	50	3, 15	0	26.0	6.13	15	77	4	30	46.8	......
Oneida	20	56	15	5	29.1	3.40	15, 27	78	4	33	49.6	2.41
Depauville	20, 30	49	11	2	26.0	4.68	27	66	4	30	45.7	1.15
Oswego	20	46	11	10	28.4	2.92	14	75	4, 5	33	45.4	1.38
Palermo	31	52	3	2	25.4	3.80	14	77	4	30	46.9	1.50
North Volney	31	54	11	7	27.6	......	14	77	4	30	47.0	......
Waterburg	30	56	14	— 2	25.9	......	15	85	4	27	41.3	......
Nichols	31	56	19	1	29.0	......	24	83	4	30	47.5	......
Newark Valley	31	54	19	— 8	27.2	4.80	16, 25, 28	78	4, 8, 9, 10	30	46.6	2.50
Himrods	31	47	3	5	26.2	4.13	27	76	4	26	45.4	3.06
Rochester	31	51	15	10	29.2	4.66	27	76	5	33	48.0	2.75
Little Genesee	31	56	19	— 9	26.8	4.05	15	82	4, 8	27	45.6	2.49
Suspension Br'dge	19, 20	48	19	12	28.2	......	27	78	5	32	48.0	1.20
Buffalo	26	55	3	11	30.1	5.41	9	73	4	32	47.1	1.15
Averages	......	......	......	......	29.4	4.14	......	......	......	......	48.0	3.03
NEW JERSEY.												
Paterson	30	58	17	18	34.3	5.56	28	85	4	33	52.2	5.64
Newark	21	55	4	18	34.8	4.56	28	81	5	31	51.1	7.00
New Brunswick	19	58	3, 9	20	36.9	3.75	28	78	4	32	......	5.78
Trenton	21	60	3	23	38.1	3.09	15	80	4	36	54.3	3.84
Rio Grande	30	52	6	22	36.5	5.43	15	82	5	31	49.7	5.00
Moorestown	20, 21	60	3	20	35.5	3.48	15	82	4	33	50.3	6.80
New Germantown	30	55	17	16	33.1	2.64	28	83	4	33	50.8	5.32
Haddonfield	21	59	3	22	35.8	3.91	28	84	4	34	51.0	5.67
Newfield	20	63	3, 5, 6	21	36.3	......	15	86	4	32	51.3	......
Greenwich	21	61	3, 5	23	37.9	3.45	28	81	4, 5	35	51.9	5.70
Vineland	21	60	5	23	36.5	3.10	15, 28	84	4	33	51.2	5.07
Averages	......	......	......	......	36.0	3.90	......	......	......	......	51.4	5.58
PENNSYLVANIA.												
Nyces	30	52	2	7	26.7	3.93	27	78	5	30	46.1	4.71
Hamlinton	20	56	17	14	30.3	4.15	24	76	4	31	48.5	4.25
Dyberry	21	56	19	1	27.4	3.35	27	81	8	26	46.3	3.00
Fallsington	20	56	6	20	36.0	3.60	15	81	4, 5	35	51.0	4.10
Philadelphia	21	61	3	23	37.9	4.52	15	82	4	34	52.5	5.41
Germantown, (M.)	21	54	3, 9, 17	20	35.5	......	15, 28	83	6	33	48.9	......
Do (T.)	21	59	3, 4, 9	23	36.0	3.20	15	82	4, 5	35	52.3	3.80
Horsham	21	59	3	21	33.6	3.53	15, 28	80	4	34	50.9	6.98
Plym'th Meeting	21	61	3	21	34.7	4.64	15, 28	80	4	33	50.5	5.79
White Hall	30, 31	58	17	14	33.3	......	15	82	8, 26	32	51.1	......
Factoryville	31	56	17	— 4	28.2	3.67	15	78	4	28	47.4	3.30
Reading	31	60	17	22	37.5	4.61	15	84	4	36	53.8	6.46
West Chester	21	63	3, 17	19	34.6	4.41	15	84	4	32	53.1	6.45
Parkersville	21	54	10	19	35.4	2.91	15	80	4	34	50.4	6.27
Ashland	30	61	17	13	32.0	4.80	15	84	4	30	51.6	5.20
Tamaqua	21	57	16	5	30.5	......	15	83	7	28	47.8	......
Ephrata	30	56	3	19	34.4	3.73	28	84	5	34	52.4	5.72
Mount Joy	30	67	16	22	38.3	......	15	85	4, 5, 7	35	53.6	......
Harrisburg	30, 31	62	17	19	39.0	3.76	15	84	4	32	53.5	4.46
Carlisle	21	60	16, 17	19	36.7	3.95	15	94	4	33	54.6	5.90
Fountain Dale	21	58	17	17	35.5	4.92	14, 15, 28	80	4	33	52.1	5.43
Tioga	31	54	17	— 8	29.2	3.95	24	84	3, 13, 26	28	48.4	8.65
Lewisburg	30	57	17	3	32.9	1.96	15	81	4	32	51.0	4.74
Grampian Hills	30	50	3, 16	8	27.0	3.99	15, 24	78	4	26	45.8	1.35
Johnstown	11, 30	54	15, 19	14	31.0	3.92	21	79	4, 8	28	48.8	2.38
Franklin	30	56	3	12	31.7	4.58	14, 24	82	8	28	50.6	2.60
Pittsburg	12	57	16	16	35.0	3.20	14, 24	78	4, 8	35	52.1	3.50
Connellsville	30	58	16	12	32.3	......	14, 24	80	4	30	50.4	......

Meteorology of 1870—Continued.

State and station.	MARCH. Date.	MARCH. Maximum temperature.	MARCH. Date.	MARCH. Minimum temperature.	MARCH. Mean temperature.	MARCH. Rain and melted snow.	APRIL. Date.	APRIL. Maximum temperature.	APRIL. Date.	APRIL. Minimum temperature.	APRIL. Mean temperature.	APRIL. Rain and melted snow.
PENN'A—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Brownsville	30	58	16	17	38.0	......	15	98	7, 8	35	54.0	......
New Castle	30	54	16	15	33.4	3.10	15	76	8	28	51.6	2.60
Beaver	12, 30	54	16	12	37.0	3.00	14	79	8	34	52.2	4.30
Canonsburg	30	63	16	11	35.3	3.25	24	87	4, 13	34	52.4	2.61
Averages	......	......	......	......	33.6	3.79	......	......	......	......	50.5	4.58
DELAWARE.												
Milford	20	62	5, 6, 17	27	39.8	3.88	28	90	4, 5	34	......	7.70
MARYLAND.												
Woodlawn	21	61	3, 17	20	35.8	3.21	15	84	4	31	51.5	6.05
Annapolis	21	64	3, 9, 17	24	47.6	3.17	28	83	5	34	53.8	5.17
Frederick	21	65	7, 9, 17	28	42.2	1.77	15	87	4, 5	40	56.6	5.44
Mt. St. Mary's	21	60	16	16	36.0	3.38	15	81	4	33	51.5	5.65
Averages	......	......	......	......	40.4	2.88	......	......	......	......	53.4	5.58
DIST. OF COLUMBIA.												
Washington	21	57	9, 17	26	40.3	3.70	15	80	5	35	53.8	3.70
VIRGINIA.												
Johnsontown	27	61	6, 10	28	43.5	4.08	15, 28	78	5	36	*52.9	3.00
Hampton	20	66	3, 9, 10	28	43.3	2.70	25	84	6	38	55.1	5.50
Zuni Station	27	64	10	26	44.1	3.61	15, 25	84	4, 5	40	56.6	3.61
Surry C. H.	......	......	......	......	......	......	15	90	4	40	58.7	8.58
Comorn	20, 21	64	6	27	42.2	1.78	15	83	5	35	55.3	2.10
Vienna, (B.)	21	64	17	22	40.0	4.00	15	86	5, 6	34	55.0	5.50
Do. (W.)	21	67	16, 17	23	40.3	3.70	15	86	4, 6	36	54.8	5.50
Piedmont	21	64	17	16	38.3	3.70	14	83	6	32	52.8	5.15
Piedmont Station	21	67	17	18	39.2	5.35	30	91	5	32	52.4	5.25
Staunton	21	60	17	19	39.1	3.66	23	89	4	34	52.7	3.92
Lexington	21	71	17	19	43.1	3.50	15, 23	86	4	38	55.7	4.51
Lynchburg	21	64	16	30	44.2	3.10	25	82	4	39	55.9	......
Snowville	19	66	17	10	37.5	3.25	28	82	8	29	50.5	5.40
Near Wytheville	20	60	17	10	37.3	4.30	24	80	5	36	52.5	2.80
Averages	......	......	......	......	40.9	3.59	......	......	......	......	54.4	4.68
WEST VIRGINIA.												
Weston	30	64	16	8	36.1	......	......	......	......	......	......	......
Cabell C. H	16, 30	48	10, 13, 17	26	37.1	2.10	15	84	3	35	54.8	1.10
Averages	......	......	......	......	36.6	2.10	......	......	......	......	54.8	1.10
NORTH CAROLINA.												
Kenansville	13, 30	70	10	28	50.7	......	23	87	5	35	60.6	......
Goldsboro	22	76	10	29	49.5	2.30	23, 25	91	5, 18	40	61.5	3.15
Warrenton	30	63	10	26	42.6	3.45	25	84	4, 5	38	55.3	2.40
Oxford	30	68	9	26	46.3	2.35	25	88	5	40	57.8	3.35
Chapel Hill	21, 22	70	9	27	47.7	......	23, 29	89	18	35	59.7	......
Albemarle	21	73	10	16	44.1	7.05	25	90	18	34	57.6	4.02
Statesville	21	67	10, 17	18	41.6	8.00	23	89	4, 7	32	54.0	2.50
Asheville, (A.)	29	68	17	14	42.1	4.55	24	81	17	32	54.3	2.80
Do. (H.)	20, 29	68	17	10	41.9	......	23, 24	76	6	30	52.1	......
Averages	......	......	......	......	45.2	4.60	......	......	......	......	57.0	3.04
SOUTH CAROLINA.												
Bluffton	21	74	10	38	57.7	5.30	25	91	18	40	63.4	2.30
Fort Mill	21	68	18	26	47.1	......	25	84	18	38	62.2	......

Meteorology of 1870—Continued.

State and station.	March.						April.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
S. C.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Gowdeysville	20, 22	69	9	23	48.7	7.58	25	90	5, 18	38	62.9	3.82
Holland's Store	29	78	10	25	51.5	10.10	24	93	5	38	65.2	2.10
Aiken	21, 29	73	17	26	52.5	6.05	24, 25	91	18	34	64.8	......
Averages	......	......	......	......	51.5	7.26	......	......	......	......	63.7	2.74
GEORGIA.												
Berne	29	75	9, 10, 18	32	54.3	5.50	24	86	6	39	61.9	0.38
Penfield	29	76	9	25	49.5	7.70	25	90	18	39	61.1	2.05
Atlanta	......	......	......	......	......	......	25	85	17, 18	32	55.2	2.82
Columbus	......	......	......	......	......	......	24	83	18	36	62.8	......
Averages	......	......	......	......	51.9	6.60	......	......	......	......	60.2	1.75
ALABAMA.												
Rockville	20, 29	72	9	24	50.6	8.25	24	87	18	34	59.5	1.13
Carlowville	29	74	9	32	59.3	7.87	26	86	17, 18	40	63.3	2.84
Selma	12	73	9, 16	31	55.1	6.15	26	85	18	38	63.2	2.15
Greene Springs	29	74	9	26	51.6	5.65	30	84	18	33	60.1	2.76
Coatopa	29	77	9	28	53.3	7.59	22, 23, 24	85	17	38	61.2	3.00
Fish River	22	76	9, 16	33	......	6.35	28	80	17	40	......	......
Averages	......	......	......	......	54.0	6.96	......	......	......	......	61.5	2.38
FLORIDA.												
Port Orange	12	82	9, 17	43	61.6	......	16	86	18	44	64.0	......
Jacksonville	29	84	9	38	61.2	5.40	25	91	18	39	67.2	3.20
Pilatka	6, 29	84	19	36	61.8	6.36	24, 25	94	18	38	67.9	1.38
Ocala	2, 29	86	18	28	62.1	......	26	92	5, 6, 7, 18	40	63.4	......
Manatee	5, 22	80	19	46	66.2	4.40	27	88	5	52	69.7	1.70
Orange Grove	......	......	......	......	......	......	28	85	5	50	67.7	2.30
Averages	......	......	......	......	62.6	5.39	......	......	......	......	66.7	2.15
TEXAS.												
Gilmer	4	83	15	22	59.8	1.82	12	88	1	40	65.4	6.41
Houston, (B)	5	89	16	29	63.1	......	8	90	15	41	62.3	......
Do...(S)	......	......	......	......	......	......	8	83	1	48	68.6	4.36
Palestine	4	83	15	21	57.5	0.50	12	83	15, 16, 17	44	67.5	7.25
Oakland	......	......	......	......	......	......	8	92	16	47	73.7	9.05
Blue Branch	11	82	15	28	56.7	1.90	8	88	15, 16	40	66.0	......
Lavaca	6	80	15	32	60.8	1.80	8	80	16	46	70.2	0.50
Clinton	11	83	16	29	63.8	3.60	8	89	1, 15	48	68.3	3.15
Austin	11	83	15	29	59.5	2.29	8	88	15	42	67.6	2.74
Lockhart	11, 14, 28	80	16	26	58.8	3.00	12, 18	83	16	42	68.5	......
Averages	......	......	......	......	60.0	2.13	......	......	......	......	67.8	4.78
LOUISIANA.												
New Orleans	4	78	16	32	57.4	2.37	13	84	1	46	64.0	3.75
Near Cheneyville	28	76	16	32	58.8	......	12	82	16	32	67.2	......
Shreveport	4	80	15	26	55.7	......	12	86	1	37	63.5	......
Averages	......	......	......	......	57.3	2.37	......	......	......	......	64.9	3.75
MISSISSIPPI.												
Columbus	29	71	9	30	51.1	5.54	22	82	18	37	60.7	3.13
Enterprise	6	76	9, 10	30	52.8	......	25	91	5, 17	38	61.2	3.60
Marion C. H.	29	76	9	28	56.1	5.30	......	......	......	......	......	......
Philadelphia	28	73	16	30	52.2	5.13	13	81	13	36	61.1	2.50
Brookhaven	6	74	9	27	53.2	7.90	13	80	16	39	60.7	6.20

Meteorology of 1870—Continued.

State and station.	MARCH. Date.	MARCH. Maximum temperature.	MARCH. Date.	MARCH. Minimum temperature.	MARCH. Mean temperature.	MARCH. Rain and melted snow.	APRIL. Date.	APRIL. Maximum temperature.	APRIL. Date.	APRIL. Minimum temperature.	APRIL. Mean temperature.	APRIL. Rain and melted snow.
MISS.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Near Brookhaven.	28	77	18	28	54.5	6.30	11, 26	86	1, 16, 17	40	61.8	5.40
Natchez	4	74	9	29	56.8	5.39	13, 14	77	16	36	61.0	4.05
Averages	......	......	......	......	53.8	5.93	......	......	......	......	61.1	4.15
ARKANSAS.												
Helena	24	73	9, 15	26	49.1	......	13, 21, 22	84	16	33	61.3	......
TENNESSEE.												
Elizabethton	20	68	17	12	41.8	3.40	26, 27	88	5	30	53.9	4.90
Tusculum College	21	64	18	24	41.9	2.80	24	80	5	36	54.5	2.10
Knoxville	21, 29	69	17	11	44.2	6.00	22	83	6	33	55.7	5.49
Lookout Mount'n.	29	67	17	18	45.7	......	24	83	17	31	57.4	......
Austin	12	68	17	17	44.5	5.27	22, 23, 24	86	6, 17, 18, 19	34	57.3	3.25
Clarksville	29	71	17	15	43.8	3.47	22	85	17	39	56.7	2.66
Trenton	12	67	9, 17	25	48.0	4.30	22, 24	84	17, 18	31	59.6	2.00
Memphis	28	71	15	26	47.1	5.65	......	......	......	......	......	......
Averages	......	......	......	......	44.6	4.41	......	......	......	......	56.4	3.39
KENTUCKY.												
Pine Grove	25	62	17	10	38.0	5.34	24	82	4, 5	32	53.7	3.93
Danville	25	68	17	21	44.7	3.63	24	90	17, 18	38	58.1	2.99
Shelby City	25	68	17	12	40.9	3.82	24	86	5, 17	34	55.9	2.88
Near Louisville	25	67	17	14	40.7	5.32	24	85	4	32	53.1	3.61
Averages	......	......	......	......	41.1	4.53	......	......	......	......	55.2	3.36
OHIO.												
New Lisbon	11, 26	50	16, 17	16	30.8	4.09	......	......	......	......	......	......
Salem	30	62	17	15	34.5	3.97	24	80	5	34	52.9	2.55
Steubenville	30	58	17	17	37.0	3.86	14	77	8	36	55.0	2.78
Painesville	30	51	16	13	31.1	2.94	24	79	4	30	49.3	5.38
Gilmore	......	......	......	......	......	......	14, 24	80	4	34	49.4	......
Milnersville	30	62	17	14	32.6	5.20	14	80	4	27	......	......
Cleveland	26	53	16	9	32.0	2.10	14, 24	82	3, 4	32	48.3	4.38
Wooster, (W)	30	62	16	4	35.7	......	......	......	......	......	......	......
Gallipolis	20	64	17	14	39.4	4.65	24	83	4	32	54.4	......
Oberlin	19, 26, 30, 31	49	16	7	32.1	3.60	24	80	3	30	48.7	2.10
Kelley's Island	19	45	16	14	33.4	3.18	14	74	3, 4, 17	36	48.4	1.89
Sandusky	20	51	16	13	33.2	3.55	24	81	3, 4	36	49.7	2.52
North Fairfield	25, 30	53	16	8	33.6	2.92	24	84	3	33	51.6	1.73
Gambier, (C.)	30	58	16, 17	18	34.8	4.87	24	76	4, 6	34	49.8	0.56
Westerville	30	61	15	16	36.7	3.39	24	85	17	34	52.6	1.14
Williamsport	12, 21, 30	58	17	14	39.8	7.18	24	85	2	27	53.6	3.70
North Bass Island	19	51	16	11	31.8	4.60	27	80	4, 5	35	47.5	1.58
Marion	30	57	15, 16	15	33.7	3.63	24	80	4	31	50.2	1.63
Hillsboro	20	58	17	12	35.8	3.78	24	78	4	33	52.3	2.78
Toledo	19	50	16	10	32.7	3.31	14, 23, 24, 27	87	4	31	50.8	2.00
Bowling Green	19, 25	51	16	5	34.0	4.00	24	86	4	32	53.1	3.30
Kenton	22, 30	48	17	25	35.4	7.70	28	66	4, 18	36	47.2	2.55
Urbana Univer'y.	25	58	15, 16	12	35.3	4.26	24	84	4, 17	32	53.8	1.14
Springfield	......	......	......	......	......	......	24	84	16, 17	35	54.4	1.60
Bethel	25	59	17	11	36.7	4.80	24	83	4, 5	33	52.4	2.75
Edgerton	20	55	9	22	34.0	4.60	......	......	......	......	......	......
Jacksonburg	25	58	15, 17	14	36.2	4.21	24	84	4, 17	32	54.1	1.15
Mt. Auburn Sem.	12, 20, 25	58	17	14	38.0	4.73	24	82	4, 17	34	55.5	1.33
Cincinnati, (H.)	25	69	17	16	39.0	3.26	24	84	4, 17	34	54.4	1.59
Do (P.)	31	64	17	15	40.7	4.80	24	84	18	35	55.5	1.42
College Hill	12	57	17	12	35.1	4.50	23, 24	84	4, 5	31	54.0	2.38
Averages	......	......	......	......	34.8	4.19	......	......	......	......	51.8	2.24

Meteorology of 1870—Continued.

State and station.	March. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	April. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MICHIGAN.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Detroit	19	47	5	0	29.9	3.40	24	82	4	33	49.7	0.96
Monroe City	10	50	16	8	32.8	2.00	14, 24, 27	82	17	35	52.8	1.03
Adrian	19	50	16	— 4	28.1	3.63	24, 27	82	4, 16, 17	29	45.3	5.94
Alpena	29	43	8, 12	10	26.6	2.60	23, 26	54	3	29	40.1	1.84
State Agr'l Col.	17, 18	50	18	10	30.3	3.01	23, 27	83	4, 5	30	50.4	2.02
Litchfield	20	52	16	2	29.2	3.60	24	82	16	27	50.5	2.58
Coldwater	20	50	15, 16	6	30.1	4.13	24	84	7, 16, 17	26	49.4	2.38
Grand Rapids, (H)	19	56	16	0	32.6	2.66	27	82	16, 17	30	51.5	......
Do. (S)	19	49	16	1	30.7	2.71	27	77	16	30	49.8	1.88
Northport	24	49	3	— 4	27.2	2.53	14	81	8	30	45.0	3.88
Benzonia	31	49	3	0	29.0	......	23	72	5	26	45.1	......
Pleasanton	28	54	3	— 2	28.5	3.25	14	78	4	28	45.4	2.50
Muskegon	30, 31	58	16	4	34.5	3.90	27	80	5	30	54.5	......
Otsego	28	58	8	18	38.3	......	13, 14, 22, 26	85	4, 5, 7	30	53.6	......
Copper Falls	24	43	11	— 4	22.9	1.30	30	68	16	26	42.6	1.30
Ontonagon	24	46	12	—14	23.4	......	12	72	2, 3, 4, 8	30	43.4	......
Averages	......	......	......	......	29.0	2.98	......	......	......	......	48.1	2.39
INDIANA.												
Aurora	25	62	17	12	38.6	3.52	24	88	4, 5, 17	32	54.7	1.92
Vevay	25	62	16, 17	16	39.1	3.93	23	86	5	31	55.4	2.37
Mt. Carmel	12, 25	56	16	12	36.1	3.05	24	82	18	32	52.7	1.83
Muncie	24	63	15	14	36.0	2.85	24	84	16	29	53.3	1.60
Spiceland	25	59	16	10	35.3	3.00	24	84	17	31	53.1	1.59
Laconia	25, 30	66	17	11	40.1	3.81	24	87	17	32	56.5	2.78
Columbia City	20, 29	54	15	9	36.2	1.78	24	85	17	24	53.3	2.31
Knightstown	25	60	16	12	37.0	2.37	24	86	17	31	53.1	1.66
Indianapolis	25	65	16	12	36.6	2.77	24	82	16	31	53.4	1.94
Near Laporte	29	62	15, 16	4	33.2	2.90	13, 24, 27	84	16	29	52.5	5.45
Rensselaer	......	......	......	......			23, 27	82	16	30	53.2	1.25
Merom	25	62	17	10	38.1	2.63	23	82	16	31	55.6	1.13
New Harmony	12	63	17	14	41.3	2.31	23	86	17	33	56.7	2.72
Harveysburg	25	58	16, 17	10	33.7	3.30	23	80	17	24	53.1	2.40
Averages	......	......	......	......	37.0	2.94	......	......	......	......	54.1	2.38
ILLINOIS.												
Chicago	24	53	15	10	35.1	1.81	13	80	16	33	52.2	1.15
Near Chicago	25	42	16	5	30.4	......	21	82	16	28	45.5	......
Evanston	25	45	16	8	31.9	3.24	13	79	16	33	47.1	1.20
Marengo	25	52	16	— 2	29.3	4.43	24	86	17	24	49.8	1.37
Charleston	25	64	15	13	37.2	3.04	23	86	16	31	54.0	1.92
Mattoon	25	55	16, 17	12	34.7	3.00	13, 14, 23	80	5, 16, 17	32	53.4	1.63
Aurora	25	53	16	3	30.3	1.92	24	83	16	29	50.9	1.58
Louisville	30	66	17	12	40.0	3.70	23, 24	88	4, 5	32	56.8	2.50
Golconda	31	79	17	10	39.3	4.60	24	92	18	26	55.9	3.80
Belvidere	25	53	16	— 2	29.5	3.69	23	86	16	27	51.7	0.69
Sandwich	25	58	16	1	32.0	3.70	23	85	4, 16	31	52.1	2.20
Ottawa	25	62	15	2	35.1	3.28	24	87	16	33	54.3	0.85
Decatur	25	62	16	9	34.7	2.97	23	86	5	31	53.4	1.30
Pana	25	63	15	10	36.3	2.70	23	83	15, 17	32	54.9	0.90
Winnebago	25	49	16	— 3	27.6	3.41	24	85	16, 17	26	50.8	1.32
Rochelle	25, 26	48	16	2	31.0	......	23, 24	84	17	28	52.3	......
Wyanet	25	57	15, 16	5	31.1	6.25	24	88	16, 17	26	51.0	0.60
Tiskilwa	25	54	15	8	33.2	......	13	86	16, 17	28	53.1	......
Hennepin, (S.)	25	60	15	6	32.0	......	23	84	4	28	53.0	......
Do. (O.)	25	58	15	8	32.3	......	23	89	4, 11, 16	30	55.8	......
Peoria	25	60	15	11	35.5	4.37	23	86	17	31	55.6	0.45
Springfield	10	63	15	6	36.2	......	......	......	......	......	......	......
Dubois	25	65	17	13	39.9	2.15	23	88	16, 17	32	53.9	2.93
Galesburg	28	62	15	2	33.2	2.80	14	79	16, 30	30	55.1	0.60
Manchester	25	63	15	5	37.2	4.61	24	86	16	28	55.2	1.95
Mt. Sterling	10	62	15	5	37.9	7.20	14	82	16	31	56.8	1.20
Andalusia	24, 25	58	15	8	33.5	......	23, 24	82	16, 17	29	52.6	......

Meteorology of 1870—Continued.

State and station.	March.						April.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
ILLINOIS—Cont'd.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Augusta	11	64	15	0	35.3	5.82	14	83	16, 17	29	55.8	0.63
Warsaw	10	66	15	2	35.5	4.45	23	92	16	29	57.2	0.83
Averages	......	......	......	......	34.0	3.78	......	......	......	......	53.2	1.44
WISCONSIN.												
Sturgeon Bay	25, 28	44	8	— 6	26.5	2.60	23	77	6	27	45.4	1.25
Manitowoc	24	45	16	4	29.3	3.58	23	70	16	31	46.8	0.58
Plymouth	6	34	3	6	......	......	......	......	......	......	......	......
Hingham	30	49	16	— 1	23.6	......	14	78	16, 17	32	47.8	......
Milwaukee	19	47	16	— 2	29.9	5.01	13	80	16, 17	28	47.0	0.51
Appleton	28	50	16	4	31.7	......	14	74	16	33	51.0	......
Geneva	25	50	16	— 3	29.3	3.35	23	84	4	28	49.8	0.15
Waupaca	18, 29	52	12	7	30.7	......	14, 23	80	16, 17	30	51.8	......
Embarrass	18	47	16	5	27.8	......	14	82	4	27	48.6	0.81
Rocky Run	19, 28	41	16	— 4	29.0	6.38	13	83	16	28	51.8	0.16
Madison	25	42	16	— 8	27.0	3.85	23	79	16	25	49.7	0.19
Edgerton	25	48	16	— 4	31.1	2.22	23	89	17	30	54.3	......
Mosinee	18, 28	46	8	— 2	25.7	3.76	13,14,23	78	4	25	46.5	2.70
Baraboo	26,28,31	50	16	—10	29.4	11.00	23	86	4, 17	26	49.9	0.75
New Lisbon	24, 25	53	16	—10	30.2	......	23	86	16	29	51.2	......
Bayfield	24	50	12	—12	24.1	......	22	72	4	24	40.8	......
Averages	......	......	......	......	28.0	3.84	......	......	......	......	48.8	0.79
MINNESOTA.												
Beaver Bay	23	51	12	—12	24.9	1.80	26, 27	69	4	27	41.3	1.60
Afton	27	47	8	—15	26.6	3.35	23	87	4	24	50.1	1.10
St. Paul	28,29,31	46	8	—10	27.5	2.10	13, 23	83	15	27	51.2	1.38
Minneapolis	28, 30	46	8	—16	25.2	2.86	23	84	15	23	49.3	1.04
Sibley	28	49	8	—23	20.2	2.22	23	80	15	18	50.4	0.17
Koniska	30, 31	50	8	—26	23.9	1.65	13	82	15	19	48.4	0.40
New Ulm	27, 30	45	8	—20	22.4	1.78	23	82	15	19	50.5	0.56
Madelia	30	48	8	—20	20.8	3.27	23	85	15	18	50.4	1.31
White Earth	28,30,31	48	7	—16	18.2	3.38	......	......	......	......	......	......
Averages	......	......	......	......	23.3	2.49	......	......	......	......	49.0	0.95
IOWA.												
Clinton	25	50	15	5	30.4	4.25	21	85	16, 17	28	51.1	0.50
Waukon	28	45	16	— 3	26.1	......	23	84	16	22	50.5	......
Dubuque	28	52	16	4	30.8	3.95	13, 24	82	16	28	52.9	0.49
Monticello	23	54	16	3	29.3	3.00	21	89	16, 17	26	53.4	1.05
Bowen's Prairie	28	56	15,16,17	4	29.1	4.35	23, 24	86	16	24	52.5	1.50
Fort Madison	25	59	15	2	33.3	4.47	21	84	17	26	53.7	0.91
Guttenberg	23	52	16	0	27.2	......	23	88	16	23	49.1	......
Mt. Vernon	28	50	15, 16	6	29.7	......	21	90	16	21	52.5	......
Iowa City	25	56	15	4	30.8	3.42	23	90	16	24	53.5	0.25
Independence	23	52	8, 16	— 1	27.3	3.13	23, 24	87	15, 16	25	52.2	0.15
Near Independ'e	25	48	16	— 2	26.7	2.20	21	88	15, 16	25	54.2	0.40
Waterloo	23	50	16	2	27.9	......	21	88	16	20	50.2	0.00
Rockford	19, 31	44	8	— 5	27.2	......	24	83	16	27	53.2	......
Iowa Falls	24	48	8	— 6	27.0	5.55	23	84	15,16,17	26	52.9	0.81
Ames	21, 28	50	8	—12	23.6	3.70	......	......	......	......	......	......
Algona	23	60	8	— 9	23.2	......	23	80	15	19	47.3	......
West Bend	25	45	8	—19	21.2	......	23	82	15	17	47.8	......
Webster City	18	46	8	—10	26.2	......	......	......	......	......	......	......
Boonesboro	24	48	8	—12	24.9	3.91	23	84	15	18	49.9	1.35
Mineral Ridge	18	50	8	— 8	28.0	......	......	......	......	......	......	......
Fontanelle	10	53	8	— 5	29.2	3.20	24	87	15	20	53.2	1.10
Grant City	27	50	8	— 7	26.0	4.30	13, 22	84	15	18	50.2	......
Sac City	......	......	......	......	......	......	13, 23	82	15	18	39.7	......
Logan	26	60	15	— 7	25.7	......	12, 13, 21, 24	82	17	16	50.1	0.40

Meteorology of 1870—Continued.

State and station.	March. Date.	March. Maximum temperature.	March. Date.	March. Minimum temperature.	March. Mean temperature.	March. Rain and melted snow.	April. Date.	April. Maximum temperature.	April. Date.	April. Minimum temperature.	April. Mean temperature.	April. Rain and melted snow.
IOWA—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Woodbine	25	60	8	— 7	26.7	1.30	13, 23	82	16	20	50.2	0.14
West Union	28	62	16	— 1	28.6	3.73	23	84	16	22	54.1	0.44
Averages	....	......	....	......	27.2	3.63	....	......	....	......	51.1	0.63
MISSOURI.												
St. Louis	10	63	15	15	40.0	2.76	24	84	16	28	56.4	2.39
Allenton	10	70	15	7	40.2	4.95	23	93	16	28	56.0	2.60
Hematite	10	67	15	9	42.1	4.05	23	91	16, 17	30	57.3	2.55
Hannibal	....	......	....	......	......	......	14	85	17	30	54.8	1.48
Rolla	10	65	15	10	40.7	4.64	23	89	17, 18	26	53.4	2.64
Jefferson City	11	68	15	6	35.0	......	25, 26	83	17	27	52.7	......
Kansas City	11	72	15	4	41.0	0.63	21	88	16	25	57.1	0.25
Harrisonville	11, 25, 27	66	15	2	38.4	0.97	21, 22	88	15, 16, 17	30	57.8	0.63
St. Joseph	11	66	15	3	37.5	1.45	21, 22	85	15, 16	31	59.6	2.20
Oregon	10	65	15	— 5	34.2	2.30	21, 22	88	16	20	56.0	1.99
Corning	....	......	....	......	......	......	23	86	16	22	54.8	2.10
Averages	....	......	....	......	38.8	2.64	....	......	....	......	56.0	1.88
KANSAS.												
Atchison	11	67	15	— 1	36.0	2.15	21	90	16	24	56.1	1.75
Leavenworth	11	70	15	— 2	34.7	1.85	21, 22	90	16	20	55.8	2.17
Olathe	11	72	15	4	38.2	2.60	22	89	16	22	55.0	1.20
Paola	11	73	15	2	38.2	0.80	13, 22	88	16	24	57.0	0.68
Baxter Springs	28	79	15	7	43.7	2.60	12	86	16, 17	32	59.4	2.80
Lawrence	11, 27	67	15	3	37.7	1.86	21	89	16	23	56.8	1.08
Williamsburg	28	70	15	— 2	36.0	......	21	86	16	17	53.5	......
Holton	19	68	15	— 2	32.1	......	21	91	16	22	57.4	......
Neosho Falls	11	74	15	2	31.4	1.00	22	87	16	24	53.4	2.00
Le Roy	28	76	15	3	39.6	1.87	21	86	16	23	55.8	2.39
State Ag'l Coll	21, 27	68	15	0	36.2	1.45	21	85	16	19	53.5	0.50
Council Grove	28	72	15	— 6	40.3	1.65	21, 22	89	16	24	57.3	1.65
Crawfordsville	11, 25	74	15	5	44.2	1.50	....	......	....	......	......	......
Averages	....	......	....	......	37.6	1.76	....	......	....	......	55.9	1.62
NEBRASKA.												
Omaha Agency	27	62	15	— 3	27.8	1.95	23	84	16	18	51.8	1.00
Blair	25	59	15	— 3	31.6	......	....	......	....	......	......	......
De Soto	25, 27	55	15	— 6	27.7	1.36	12, 13, 21	83	16	18	52.9	0.62
Bellevue	10	64	15	0	32.5	1.00	21	88	16	23	54.4	2.70
Nebraska City	10	66	15	0	32.4	2.15	21	89	16	22	55.7	2.00
Lincoln	27	57	15	— 5	34.2	......	12	84	16	23	51.7	2.40
Averages	....	......	....	......	31.0	1.62	....	......	....	......	53.3	1.74
UTAH.												
Gt. Salt Lake City	20	64	14	9	39.2	......	28	78	15, 30	30	51.4	......
Coalville	26	60	15	—18	32.8	1.60	29	78	1, 6, 14	31	48.0	......
CALIFORNIA.												
Monterey	29	67	7	35	50.3	1.91	26	76	5, 14	37	54.2	1.44
Chico	31	72	5, 6, 14	32	51.8	3.44	18, 24, 26	87	13	38	60.7	0.85
Watsonville	28	76	5	35	52.2	2.01	16, 25	80	5	32	56.0	1.21
Vacaville	25, 26, 28	66	14	34	51.3	1.62	18, 24, 26	80	4, 5	42	57.3	0.84
Cahto	28, 29	66	14	34	48.0	10.00	18, 26	80	4	35	53.8	6.00
Visalia	29	79	5	30	51.2	0.55	19, 26	87	5	38	60.5	1.40
Clayton	25	69	14	30	50.5	1.38	18	86	13	42	59.2	1.36
Averages	....	......	....	......	50.8	2.99	....	......	....	......	57.4	1.87

Meteorology of 1870—Continued.

State and station.	MARCH. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	APRIL. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MONTANA.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Deer Lodge City	30	62	14	—28	26.5	1.11	25	76	14	16	45.6	1.47
Missoula Mills	31	70	15	— 6	39.5	......	....	......	....	......	......	......
COLORADO.												
Denver	27	67	14	— 8	32.7	0.70	12	80	15	16	48.1	2.80
WASHINGTON.												
Port Angeles	31	52	13	19	43.4	7.40	[illegible]	[illegible]	12	42	47.7	3.25
Seattle	31	73	13	14	41.5	......	25, 29	82	10, 12	40	52.0	......
Cathlamet	31	63	13	17	40.6	......	24, 25	77	12, 15, 22	39	49.3	......
OREGON.												
Portland	28	63	13	18	43.4	4.30	25, 27	80	23	41	53.6	4.30
Eola	31	56	13	20	39.4	5.77	25	[illegible]	23	[illegible]	[illegible]	[illegible]

State and station.	MAY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	JUNE. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MAINE.												
Houlton	30	96	4	32	51.9	1.90	5	97	1	54	70.1	2.40
Steuben	29	80	4	37	49.6	1.05	....	......	....	......	......	......
Surry	....	......	....	......	......	......	25	90	9, 10	54	67.6	......
Orono	29	80	6	36	51.9	1.96	25	89	10	53	65.7	2.07
Williamsburg	30	83	10, 24	34	51.9	2.70	24, 25	89	12, 21	50	67.1	2.70
West Waterville	30	82	10	38	55.2	1.67	4, 25	90	10, 11	52	69.2	1.38
Gardiner	20	79	10	39	54.3	1.90	25	88	10	47	65.9	1.94
Lisbon	20	83	6	37	53.4	1.53	25	96	3, 9, 10	51	67.1	3.23
Norway	29	82	7	36	55.5	1.40	24	94	21	50	69.5	1.50
Cornish	15	81	7, 10	38	55.0	1.55	24	94	9, 10	50	68.9	3.97
Cornishville	15, 20	82	7, 10	40	57.1	1.55	25	[illegible]	9, 10	[illegible]	71.0	3.40
Averages	....	......	....	......	53.6	1.72	....	......	....	......	68.2	2.51
NEW HAMPSHIRE.												
Stratford	30	86	5, 12	33	53.0	2.18	5, 24	92	21	48	66.3	1.63
Whitefield	29	85	7	31	52.2	1.74	24	92	21	51	69.5	4.56
Tamworth	30	83	7	37	56.6	1.03	25	95	29	53	70.5	2.63
Concord	15, 20	79	7	39	56.5	......	....	......	....	......	......	......
Goffstown Center	16	87	7	37	59.4	3.17	25	100	10, 11	[illegible]	[illegible]	4.19
Averages	....	......	....	......	55.2	2.03	....	......	....	......	69.1	3.25
VERMONT.												
Lunenburg	30, 31	82	7	35	54.1	4.00	29	94	22	50	69.4	3.50
North Craftsbury	30	80	13	34	52.1	1.72	25	88	20, 21, 22	50	68.8	3.73
Newport	19, 30	84	12	37	56.5	1.70	5	91	21	53	71.5	4.30
East Bethel	19, 30	85	2, 6	35	57.3	1.17	25	95	21, 22, 30	55	[illegible]	2.45
Woodstock	15, 16, 19	79	11, 12	39	54.1	1.83	25	89	10, 21	52	68.0	5.35
Near St. Albans	30	82	12	40	56.5	......	24	89	21	53	72.1	2.50
West Charlotte	30	88	7	38	58.2	0.75	25	96	22	57	74.3	6.93
Middlebury	15	80	22	43	57.9	0.59	25	85	22	55	70.9	3.77
Panton	30	86	12	42	59.4	0.31	24, 25	94	21	54	75.3	4.36
Castleton	15	82	2, 6	41	57.6	1.23	25	90	22	55	[illegible]	[illegible]
Averages	....	......	....	......	56.4	1.48	....	......	....	......	71.4	[illegible]
MASSACHUSETTS.												
Kingston	15	86	17	39	53.6	3.25	25	95	21	53	68.9	2.00
Topsfield	15	84	10, 11	40	55.5	2.04	25	93	10, 11	50	67.7	1.79
Lawrence	15	81	9, 10, 11	40	55.3	1.49	25	99	10	48	68.9	3.49
Newbury	....	......	....	......	......	......	25	101	10	50	70.7	......
Milton	15	86	10, 11	42	57.8	2.80	25	98	10, 11	54	70.1	2.60
Cambridge	15	86	11, 17	43	58.8	......	25	96	11	53	72.3	......
North Billerica	16	81	9, 11	40	57.9	......	25	95	11	52	71.0	......

Meteorology of 1870—Continued.

State and station.	MAY. Date.	MAY. Maximum temperature.	MAY. Date.	MAY. Minimum temperature.	MAY. Mean temperature.	MAY. Rain and melted snow.	JUNE. Date.	JUNE. Maximum temperature.	JUNE. Date.	JUNE. Minimum temperature.	JUNE. Mean temperature.	JUNE. Rain and melted snow.
MASS.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
West Newton	20	92	11	42	60.3	0.53	25	104	11	52	73.8	7.96
New Bedford	15	80	10, 11	42	54.4	3.39	25	90	21	54	66.7	3.48
Worcester	16	81	7, 11	41	57.1	2.40	25	92	10	51	69.7	2.09
Mendon	15	82	11	39	56.5	1.90	25	92	10	49	69.1	3.40
Lunenburg	15	86	11	41	57.4	4.30	25	97	10	50	71.0	3.80
Amherst	15, 16	82	11	43	58.3	1.72	25	93	10, 11	54	70.5	2.73
Richmond	19	90	8, 10	40	63.5	4.08	20	92	13	56	73.8	9.86
Williams College	19	81	2, 5, 6, 11	42	58.2	1.27	25, 27	89	22	54	70.0	5.05
Hinsdale	16	79	11	38	55.3	1.03	27	89	10, 11	48	69.0	5.80
Averages	......	......	......	......	57.3	2.32	......	......	......	......	70.2	4.16
RHODE ISLAND.												
Newport	26	75	11	43	54.8	3.54	25, 28	86	11, 22	58	68.2	2.11
CONNECTICUT.												
Columbia	16	92	11	43	60.2	1.16	25	95	10	54	71.9	3.55
Middletown	16	89	7	42	59.5	1.59	24, 25	95	11	53	71.8	2.72
Southington	16	85	11	42	59.6	1.31	25	92	11	52	72.7	4.35
Colebrook	16	84	11	40	58.4	2.85	25	90	10, 11	53	70.3	7.06
Brookfield	15	86	2	40	59.2	3.50	25	94	{2, 7, 10, 11, 22}	60	71.2	4.60
Averages	......	......	......	......	59.4	2.08	......	......	......	......	71.6	4.45
NEW YORK.												
Moriches	16	85	10, 11	47	59.2	2.38	28	102	10	58	71.9	1.12
South Hartford	15, 16	85	11, 22	49	61.0	0.65	27	94	22	57	75.4	3.35
Fort Edward	15	82	11	43	59.0	......	......	......	......	......	......	......
Garrison's	15, 16	85	10, 11	46	58.3	2.98	25, 28	92	11	56	72.5	3.00
Throg's Neck	17	83	11	47	62.4	......	25	93	11	56	71.9	......
White Plains	16	77	10	46	59.9	......	28	89	11	57	72.2	......
Cooper Union	16	83	11	47	62.8	3.08	25	93	11	57	74.1	2.85
Rutger F. College	15, 16	86	3, 11	48	64.7	2.55	25	95	10, 11	60	76.7	1.02
Flatbush	16	85	10, 11	47	61.5	2.63	25	93	10	55	75.1	1.73
Brooklyn	......	......	......	......	......	......	25, 28	96	11	59	74.7	3.38
Glasco	15	93	4, 11	39	59.2	2.00	25	96	3	52	73.4	3.13
Newburg	15, 16	90	11	46	63.3	2.49	25	95	10	59	75.4	4.63
Minaville	16	85	2	43	62.1	2.90	28	95	22	53	74.3	3.50
Bannerville	16	84	30	30	58.3	......	27	100	10	57	74.3	4.00
Cooperstown	19	84	2	40	59.2	1.94	27	92	22	52	72.5	0.95
Gouverneur	30	86	1	41	57.2	1.01	25	90	21	50	70.7	3.50
North Hammond	30, 31	90	22	41	66.0	0.68	25	95	21, 22	60	78.4	0.97
Houseville	30	85	12	43	59.1	1.30	25, 27	92	21	53	72.8	0.80
Leyden	19	77	12	42	56.7	1.29	......	......	......	......	......	......
Utica	30	85	1	43	60.6	1.86	28	94	22	53	73.7	3.29
South Trenton	30	86	1	40	59.3	2.77	28	94	6	50	71.2	3.81
Cazenovia	19	82	1	40	58.8	......	27	92	22	55	71.2	......
Oneida	19	83	2, 6, 12	45	60.2	3.36	28	93	21	53	72.8	4.59
Depauville	29	82	22	40	57.7	1.34	28	90	22	53	70.8	2.27
Oswego	31	80	1	42	55.8	0.83	3	82	21	55	68.3	2.15
Palermo	19	84	1	42	58.5	0.30	25	92	21	52	71.6	0.70
North Volney	31	85	1	45	59.8	......	25, 27	93	21	53	72.9	......
Waterburg	19	90	1	40	59.8	......	25	94	21	49	72.6	......
Nichols	19	89	2	41	60.0	......	25	95	21	50	71.5	......
Newark Valley	19	85	2	37	60.0	3.10	25	94	21, 22	50	70.9	3.40
Himrods	19	80	21	45	58.2	3.19	25, 26, 27	89	21	52	70.4	2.69
Rochester	16, 19	82	7, 12	46	61.2	0.73	27	92	21	59	73.0	2.96
Little Genesee	19	87	2	36	56.0	1.42	25	94	22	48	69.3	4.57
Suspens'n Bridge	20	87	1	38	59.2	0.80	25	99	22	50	70.9	5.35
Lockport	......	......	......	......	......	......	26	91	21	56	70.8	4.37
Buffalo	20	83	12	41	58.8	1.51	29	95	21	55	70.5	6.30
Averages	......	......	......	......	59.8	1.89	......	......	......	......	72.6	3.01

Meteorology of 1870—Continued.

State and station.	MAY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	JUNE. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
NEW JERSEY.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Paterson	16	88	10	47	62.8	2.96	20	95	10	57	74.4	4.20
Newark	16	82	1	43	60.4	2.00	28	93	11	55	72.3	3.13
New Brunswick	16	83	10, 11	47	59.6	3.00	......	......	......	......	......	......
Trenton	15	84	11	50	65.2	3.40	26	94	1, 10, 11	62	77.2	3.27
Rio Grande	16	87	12, 17	49	61.3	9.50	26, 30	96	2, 3	60	74.0	3.25
Moorestown	16	83	5	46	61.5	6.59	28	95	4	57	73.3	2.80
New Germantown	16	86	11	47	61.2	2.99	28	93	11	58	73.0	5.56
Readington	16	85	......	......	67.7	......	28	94	1	60	75.8	......
Haddonfield	16, 21	82	11	48	61.1	4.74	28	92	1	59	73.0	2.80
Newfield	21	92	11	47	63.9	......	19	100	1	61	76.0	......
Greenwich	16	80	3	50	62.7	7.40	26, 29	92	2	61	74.1	2.38
Vineland	25	88	5	46	63.8	8.45	29	99	1	57	76.1	4.32
Averages	......	......	......	......	62.6	5.10	......	......	......	......	74.5	3.52
PENNSYLVANIA.												
Nyces	16	82	11	44	58.0	2.00	......	......	......	......	......	......
Hamlinton	16	84	11	45	64.1	1.70	27	91	21	52	70.9	4.65
Dyberry	15, 16	83	2	35	58.3	3.15	28	96	21, 22	52	69.4	2.90
Fallsington	16	85	11	49	63.3	3.70	26, 28	94	10, 11	60	74.7	3.60
Philadelphia	21	86	11	50	63.8	5.24	28	94	11	61	76.4	2.54
Germantown. (M)	21	88	27	50	65.3	......	25, 26, 28	96	22	60	75.7	......
Do. (T)	16	85	11	49	62.9	7.38	28, 29	94	7	57	74.3	2.36
Horsham	16	80	11	47	57.0	8.43	28	91	1	58	72.1	4.25
Plymouth Meet'g	16	83	11	48	61.6	6.66	28	92	1, 22	59	73.2	3.40
White Hall	16	88	2	38	63.4	......	29	93	22	53	74.0	......
Factoryville	30	82	2	40	59.7	4.09	27	94	22	54	71.0	4.92
Reading	15, 16	86	3, 13	51	63.7	3.91	26	94	22	61	74.6	5.69
West Chester	21	85	11	46	62.0	5.25	29	95	11	59	73.9	6.15
Parkersville	16	85	3	46	62.1	3.90	29	96	1, 11	60	74.5	5.60
Ashland, (H)	21	90	11	42	63.6	......	......	......	......	......	......	......
Do. (C)	15	84	2	40	61.0	......	......	......	......	......	......	......
Tamaqua	16	84	1	35	59.5	4.30	27	91	21	47	69.9	8.30
Catawissa	......	......	......	......	......	......	27	94	21	52	69.8	......
Ephrata	16	86	12	42	62.4	3.50	19, 24, 27, 28, 29	94	11	58	72.0	4.73
Mount Joy	22	88	12	47	63.3	......	20	99	1, 2, 11, 12	61	75.4	......
Harrisburg	15, 16	85	11	50	64.8	4.07	26	95	1, 11, 22	67	77.0	7.66
Carlisle	16	92	2, 11, 12	50	65.1	6.30	26	96	12	57	74.3	7.80
Fountain Dale	16	83	2	49	62.9	4.28	26	94	11	57	72.5	6.70
Tioga	15, 16, 19, 20, 21	84	2, 6	40	60.1	2.50	27	94	22	48	70.6	3.30
Lewisburg	15	84	11	46	62.1	3.19	26, 28	93	1	52	72.2	5.17
Grampian Hills	19	86	11	40	59.1	5.61	24, 25, 28	92	11, 22	50	68.0	2.83
Johnstown	19	86	2	34	61.0	4.50	25	92	21	52	67.8	4.02
Franklin	19	88	1	45	63.1	3.82	27	95	22	52	70.3	5.60
Pittsburg	19	87	1	47	64.7	3.00	26	91	11	56	71.3	3.40
Connellsville	19	88	10, 11, 13	46	63.1	......	26, 27	98	11	50	72.6	......
Brownsville	24	88	2, 3	48	68.0	......	27	92	9, 22	60	75.0	......
New Castle	19	85	11	42	65.3	5.20	26	90	22	51	72.1	4.90
Beaver	19	87	10	47	67.4	5.10	26	89	10, 12, 13, 21	57	69.5	6.00
Canonsburg	18, 19	89	2	43	64.3	3.41	26, 27	93	22	52	70.6	2.83
Averages	......	......	......	......	62.6	4.39	......	......	......	......	72.5	4.78
DELAWARE.												
Milford	20	88	11	46	63.5	4.60	28, 29	96	1	59	76.5	2.80
MARYLAND.												
Woodlawn	16	85	5, 11, 27, 28	50	63.0	5.06	28	94	22	58	73.1	5.81
Annapolis	4	82	11, 12	52	66.3	5.33	28	96	2	62	76.6	4.38

Meteorology of 1870—Continued.

State and station.	May. Date.	May. Maximum temperature.	May. Date.	May. Minimum temperature.	May. Mean temperature.	May. Rain and melted snow.	June. Date.	June. Maximum temperature.	June. Date.	June. Minimum temperature.	June. Mean temperature.	June. Rain and melted snow.
MD.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Frederick	16	88	1, 27, 28	56	68.2	5.06	26	97	12	62	77.4	10.75
Mt. St. Mary's	4, 21	83	11	47	62.6	4.37	26	92	12	55	71.4	9.60
Averages	......	......	......	......	64.8	4.96	......	......	......	......	74.6	7.64
DIST. COLUMBIA.												
Washington	4, 16	81	3, 11, 12, 28	54	64.5	4.70	28	93	2	63	75.0	4.45
VIRGINIA.												
Johnsontown	24	81	5	52	63.7	5.70	28	94	1	58	74.6	3.20
Hampton	24	90	11	52	66.0	5.30	26, 28	98	1, 3	64	76.5	7.70
Zuni Station	24	88	12	48	67.2	7.59	26	98	12	64	78.5	5.02
Surry C. H.	24	94	11	50	69.1	7.85	28	102	1,3,4,11	68	80.7	6.06
Comorn	16	82	11	52	65.5	4.15	28	92	1	64	76.0	4.75
Vienna, (B)	21	88	11	48	66.1	......	27, 28	98	1	64	77.5	......
Do. (W)	22	86	2	48	67.6	4.70	26, 28	91	11	60	73.6	4.70
Fairfax C. H	......	......	......	......	......	......	30	108	22	56	76.1	3.40
Piedmont	15	85	12	42	68.4	5.60	26, 28	94	11	57	72.6	6.81
Piedmont Station	20	85	12	42	63.4	5.30	26	94	22	58	72.9	7.70
Staunton	17, 21	81	11, 28	49	62.7	5.89	24, 25	89	11	56	71.8	6.73
Lexington	21	91	14	48	66.1	5.40	27	99	11, 12	58	74.5	3.60
Lynchburg	22	83	12	48	66.6	2.75	27	90	12	58	73.4	......
Snowville	23	88	12	35	60.4	3.60	27	92	11	51	68.9	6.10
Near Wytheville	23	84	12	40	61.5	2.30	24,25,26	86	9, 11	56	68.0	5.80
Averages	......	......	......	......	65.3	5.09	......	......	......	......	74.4	5.51
WEST VIRGINIA.												
Weston	19	90	1	34	61.2	......	26, 27, 28	95	6	48	70.2	......
Cabell C. H	30	91	11, 12	38	68.2	0.50	28	98	11	48	75.0	4.70
NORTH CAROLINA.												
Kenansville	22	97	12	48	69.2	......	......	......	......	......	......	......
Goldsboro	22	94	12	51	71.3	4.85	27	103	4	59	80.1	7.95
Warrenton	17, 24	86	11, 12	48	65.5	4.30	26	95	2	64	74.7	2.40
Oxford	22	86	3	50	66.6	9.75	28	96	2, 3	63	75.9	2.10
Chapel Hill	22	92	10, 11, 13	50	69.1	......	......	......	......	......	......	......
Albemarle	5	92	13, 14	44	65.4	6.72	28	100	11	56	74.8	3.17
Statesville	17, 21	88	14	42	63.8	4.50	26, 27, 28, 29, 30	94	10, 11, 12	56	73.1	7.50
Asheville, (A)	22	86	10	45	63.0	6.70	26	87	14	54	68.8	4.70
Do... (H)	21, 22	82	12	36	61.2	......	23, 24, 26, 30	80	10, 14	52	67.2	......
Averages	......	......	......	......	66.1	6.14	......	......	......	......	73.5	4.64
SOUTH CAROLINA.												
Bluffton	17	92	2	60	74.3	2.70	26	95	2, 9, 10, 19	71	79.8	9.30
Fort Mill	21	90	12	52	70.3	......	30	94	12	60	75.1	......
Gowdeysville	22	90	13	53	76.3	3.65	......	......	11	62	75.6	3.18
Aiken	17, 18, 21	91	11, 13	60	72.9	1.92	30	92	10	61	75.7	8.31
Averages	......	......	......	......	73.5	2.76	......	......	......	......	76.6	6.93
GEORGIA.												
Berne	17	90	1	56	71.6	1.20	30	91	10, 12, 13	68	76.9	2.68
St. Mary's	17	88	15	60	73.0	......	30	91	11	68	78.0	......
Penfield	22	93	13	52	71.2	1.40	28	94	10, 11	60	75.7	2.66
Atlanta	21, 22, 23	92	10, 11, 12	50	65.4	0.68	27	96	10, 11	51	71.4	4.46
Averages	......	......	......	......	70.3	1.09	......	......	......	......	75.5	3.23

Meteorology of 1870—Continued.

State and station.	MAY. Date.	MAY. Maximum temperature.	MAY. Date.	MAY. Minimum temperature.	MAY. Mean temperature.	MAY. Rain and melted snow.	JUNE. Date.	JUNE. Maximum temperature.	JUNE. Date.	JUNE. Minimum temperature.	JUNE. Mean temperature.	JUNE. Rain and melted snow.
ALABAMA.												
		Deg.		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Rockville	24	94	11, 13	53	69.7	1.88	27	95	10	58	78.1	4.00
Carlowville	22, 23	96	11	60	76.1	0.78	27	96	11	66	78.2	6.99
Selma	21	97	9	56	75.0	0.55	......	......	......	......	......	......
Greene Springs	22, 23	94	12	47	68.8	0.50	27	95	10, 13	57	75.9	3.75
Coatopa	22	97	12	51	72.8	1.00	27	95	13	59	75.2	5.20
Fish River	30	87	17	63	......	1.00	......	......	......	......	......	......
Averages	......	......	......	......	72.5	0.95	......	......	......	......	76.9	4.99
FLORIDA.												
St. Augustine	6, 17, 18	90	28	60	76.2	......	4, 29, 30	92	11	68	79.1	3.10
Jacksonville	17	95	15	60	75.7	1.50	28	95	10,11,12	71	79.2	8.10
Pilatka	......	......	......	......	......	......	26, 27, 29, 30	98	13	72	81.1	7.80
Ocala	17	96	10	55	71.4	......	3, 28	95	10	65	80.2	......
Manatee	31	92	1, 3, 11, 14, 15, 16	70	79.0	2.00	6, 7, 19, 28, 29	92	13	74	83.5	4.50
Orange Grove	30, 31	88	14	65	76.4	2.10	24, 25	90	10	71	80.5	5.40
White Spring	......	......	......	......	......	......	27	96	11	67	80.7	......
Newport	18	94	14	58	74.2	1.29	6	92	10	69	77.8	6.88
Chattahoochee	19	99	7	47	......	......	27	95	7	66	......	6.50
Averages	......	......	......	......	75.5	1.72	......	......	......	......	80.3	6.04
TEXAS.												
Clarksville	......	......	......	......	......	......	21, 22, 26	89	12	63	78.7	......
Gilmer	21	92	12	57	74.0	2.65	22, 26	95	9, 13, 14	62	78.7	7.37
Houston	1	90	26	58	73.6	......	......	......	......	......	......	......
Palestine	21	91	6	59	75.8	3.80	......	......	......	......	......	......
Oakland	25	94	15	63	76.7	1.25	6, 7	95	13	70	80.6	5.00
Blue Branch, (W)	25, 26	89	9	60	73.4	8.80	5, 19	89	9	68	78.0	1.60
Do (G)	25, 26	91	......	......	......	......	27	95	9, 10	70	81.3	1.80
Lavaca	25,26,27	90	3	68	76.3	0.20	12	92	10	72	81.4	0.40
Bluff	......	......	......	......	......	......	4, 6	94	9, 10, 13	72	81.4	3.24
Clinton	26	95	1	66	77.5	0.10	15, 30	98	10, 18	72	82.4	1.75
Austin	25, 26	94	12	63	75.2	6.98	27	91	9	64	78.8	2.60
Lockhart	25, 26, 28, 29	92	7	60	75.1	......	4, 5, 7, 27	94	9, 13	72	83.8	2.20
San Antonio	......	......	......	......	......	......	5, 6, 15	100	9	66	81.3	3.28
Averages	......	......	......	......	75.3	3.40	......	......	......	......	80.6	2.93
LOUISIANA.												
New Orleans	22	92	9	61	73.0	1.90	3, 4, 28, 29	89	10, 13	68	77.6	2.39
Near Cheneyville	22	92	12	56	78.2	......	4, 30	90	14	68	79.4	......
Shreveport	20, 21	92	15	56	75.3	......	22	93	11, 13	67	79.4	......
MISSISSIPPI.												
Columbus	22	92	11	52	71.9	6.10	30	93	10	61	77.3	3.39
Enterprise	20,21,23	100	14	50	75.8	......	28	103	16	60	83.5	5.20
Philadelphia	22	90	8, 12	54	70.8	1.70	29, 30	90	13	58	74.2	5.30
Brookhaven	23	91	12	48	71.4	1.30	22, 30	90	13, 20	60	76.7	3.00
Near Brookhaven	23	97	12	50	71.9	2.30	28, 29, 30	97	12	58	77.4	4.40
Natchez	21, 22, 23	83	8, 9, 12, 13, 15	60	73.1	0.82	......	......	......	......	......	......
Averages	......	......	......	......	72.5	2.41	......	......	......	......	77.8	4.26
ARKANSAS.												
Helena	23	93	7	52	71.8	......	22	94	8, 11, 12	60	76.5	......

Meteorology of 1870—Continued.

State and station.	MAY. Date.	MAY. Maximum temperature.	MAY. Date.	MAY. Minimum temperature.	MAY. Mean temperature.	MAY. Rain and melted snow.	JUNE. Date.	JUNE. Maximum temperature.	JUNE. Date.	JUNE. Minimum temperature.	JUNE. Mean temperature.	JUNE. Rain and melted snow.
TENNESSEE.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Elizabethton	21	96	11	42	65.9	4.45	26, 27	94	10,11,13	54	71.4	14.15
Lookout Mount'n.	23	90	7	50	68.8	......	22, 23, 25, 26, 28	83	10	54	74.3	......
McMinnville	23	90	15	50	......	......	22, 23	89	10, 11	55	70.5	......
Austin	23	94	13	46	68.5	2.78	24, 25, 26, 27	91	10,11,13	56	69.5	8.90
Clarksville	22	88	11	47	65.8	3.76	23	88	11	53	70.8	8.11
Trenton	22	95	13	46	70.2	4.70	23	93	11	53	74.5	5.60
Knoxville	23	88	12	46	66.2	5.20	27	89	11	55	72.7	5.50
Averages	......	......	......	......	67.6	4.18	......	......	......	......	72.0	8.45
KENTUCKY.												
Pine Grove	23	90	8, 10, 11, 12, 13	50	66.2	3.59	25	92	9, 11	54	71.4	3.64
Danville	23	95	11, 12	52	69.9	4.18	25	96	10	56	75.1	3.57
Shelby City	23	90	10, 12	50	67.9	3.45	25	92	12	59	73.9	5.50
Near Louisville	22	93	11	43	66.3	4.71	24, 25	94	10	52	73.1	2.97
Averages	......	......	......	......	67.6	3.98	......	......	......	......	73.4	3.92
OHIO.												
Salem	19	90	10, 13	52	65.7	2.40	26, 27	95	21	52	70.4	4.01
Steubenville	19, 21	84	1, 2	50	67.6	3.04	25	90	22	53	74.0	4.33
Painesville	18, 21	82	11	45	62.6	3.06	25,26,30	89	10	54	69.1	6.75
Gilmore	18	94	10,11,12	48	68.2	4.20	28	102	9	52	65.5	5.80
Milnersville	20	86	13	40	......	......	25	93	22	48	70.3	4.26
Cleveland	3	84	10,11,12	45	60.1	1.85	26	91	10, 12	52	68.3	2.3[illegible]
Wooster, (H)	......	......	......	......	......	......	26	102	12	56	73.9	......
Pennsville	23	87	14	50	69.1	1.25	24,25,27	92	11, 12	53	71.6	2.60
Gallipolis	23	90	8	49	66.2	......	26	94	12	53	72.3	......
Adams' Mills	......	......	......	......	......	......	26	94	11	55	71.8	3.65
Oberlin	18	88	12	43	67.7	1.35	25	98	9, 21	51	70.8	1.25
Kelley's Island	18	84	7, 8	51	63.9	1.27	26	93	10	60	73.1	3.85
Sandusky	18	85	11, 29	50	71.7	2.17	25,26,28	90	10	59	73.1	5.09
North Fairfield	3, 18	84	13	46	64.2	2.63	26	92	11	54	69.6	2.91
Gambier	23	84	10, 12	49	68.0	1.15	26, 28	89	11	51	68.0	2.93
Westerville	18, 19	89	10	46	66.7	0.77	26,28,30	94	10	50	73.1	3.77
Williamsport	20	93	1	43	69.8	1.83	......	......	......	......	......	......
North Bass Island	16	87	7	51	63.0	1.57	28	97	9, 21	59	72.5	2.74
Marion	18	87	13	46	68.8	1.36	26	93	11	54	70.3	5.14
Hillsboro	23	86	10, 11	47	65.1	1.88	25	92	11, 12	54	69.9	3.27
Toledo	18	92	1	47	64.5	3.13	25	98	11	55	72.6	4.06
Bowling Green	3	91	10, 12	48	65.9	1.90	28	102	11	51	74.5	3.20
Kenton	23	90	1, 4	50	68.1	1.35	26	101	12,14,16	60	77.1	5.51
Urbana Univer'y.	18	89	12	46	65.6	0.68	26	93	10, 11	54	71.0	2.47
Springfield	21	89	8, 11	50	68.7	0.45	26	96	11	54	73.5	2.20
Bethel	23	91	13	47	65.9	2.25	25, 28	93	11	53	60.3	3.13
Jacksonburg	18,21,22	88	10, 13	46	67.2	0.40	21, 25	96	11, 13	52	72.5	3.25
Mt. Auburn Sem.	22	88	10,11,12	51	71.0	1.82	26	92	11	55	74.3	4.76
Cincinnati, (H)	22	92	11	49	68.0	1.74	25	97	11	55	73.1	4.84
Do ......(P)	23	94	11	50	70.7	1.90	26	95	10	58	76.7	4.25
College Hill	22, 23	90	9, 10	50	71.2	1.18	28	97	10	50	76.0	4.31
Averages	......	......	......	......	66.9	1.80	......	......	......	......	71.6	3.83
MICHIGAN.												
Detroit	16, 31	86	9	46	62.5	1.26	2[illegible]	96	10, 11	53	69.5	3.67
Monroe City	16	89	12	48	64.7	1.71	28	98	11	56	73.6	4.55
Ann Arbor	3, 18	85	12	47	62.9	1.70	25, 30	95	11	52	70.8	2.9[illegible]
Adrian	3	90	12, 24	42	59.1	6.71	28	100	8	46	68.6	6.11
Alpena	19	76	1,6,7,11	42	52.3	1.73	26	80	11	41	62.6	3.11
State Agr'l Coll	14	8[illegible]	21	41	64.3	1.16	19, 27	98	7	49	70.9	7.27
Litchfield	18	89	8	46	62.3	2.30	24, 30	92	10	50	69.1	5.45

Meteorology of 1870—Continued.

State and station.	MAY.						JUNE.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MICH.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Cold Water	18	87	13	40	61.7	1.31	24	96	8	52	68.7	4.31
Grand Rapids, (H)	31	93	8	48	65.1	0.93	27	102	10	53	73.1	3.66
Do (S)	31	84	8	46	62.3	0.87	27, 30	94	13	50	69.6	6.15
Northport	15	82	9, 24	44	57.5	3.63	27	93	9, 12	48	66.3	3.50
Benzonia	31	92	8, 12	42	60.1	......	......	......	......	......	......	......
Pleasonton	31	90	12	36	61.3	1.00	25	99	10	43	67.6	3.35
Muskegon	17	90	9	48	68.1	1.00	25, 26	94	15	52	73.2	5.00
Otsego	15	98	10	42	66.7	......	25	106	9	48	70.9	......
Copper Falls	30	79	16	36	55.5	0.90	23	91	9, 10	41	64.7	1.00
Ontonagon	30, 31	90	16, 25	46	52.4	......	22, 24, 28, 29	90	12	48	67.6	......
Averages	......	......	......	......	61.5	1.87	......	......	......	......	69.2	4.29
INDIANA.												
Aurora	22	96	1, 9, 11, 12	48	66.9	1.93	24, 25	100	10, 11, 13	54	71.0	3.01
Vevay	22	90	9	46	66.8	2.37	25	95	10	56	72.8	3.80
Mount Carmel	22	87	9	45	65.7	1.00	25	94	11	54	73.0	3.80
Muncie	5, 17, 22	88	11	44	66.5	1.85	......	......	......	......	......	......
Spiceland	22	94	10, 11, 12	45	67.6	0.51	25	96	10	51	72.6	5.36
Laconia	22	92	10	46	66.1	6.50	25	93	10, 11, 12	56	72.9	2.06
Columbia City	18	90	10	48	67.5	0.00	25, 26	98	8, 9, 11	56	74.1	4.00
Knightstown	22	91	12	45	67.5	0.85	25	98	11	52	72.9	6.12
Indianapolis	22	90	12	42	67.3	0.56	......	......	......	......	......	......
Near La Porte	17	94	11	45	67.4	0.65	30	97	9, 11, 13	55	72.2	3.25
Rensselaer	22	92	12	47	67.2	1.60	29	98	11	53	73.3	6.85
Merom	22	88	12	45	68.5	1.60	25	98	10	53	73.9	2.75
New Harmony	22	91	11	50	68.4	1.72	24, 30	94	11	55	74.2	3.94
Harveysburg	22	88	10, 11, 29	40	60.7	1.70	......	......	......	......	......	......
Averages	......	......	......	......	66.7	1.63	......	......	......	......	73.0	4.09
ILLINOIS.												
Chicago	3, 15	85	7, 11	47	65.5	0.80	30	100	8	54	71.8	1.70
Near Chicago	3	88	10	42	61.1	......	30	100	8, 11, 13	54	68.9	......
Evanston	3	85	11	45	61.5	1.21	30	97	8	52	63.1	1.37
Marengo	16, 31	88	10	42	63.6	0.54	30	100	11	45	69.8	0.99
Charleston	22	89	10, 12	45	66.2	2.63	25, 30	94	9, 10	53	72.7	2.86
Mattoon	22	85	12	45	66.9	2.63	24, 25	93	9	54	73.3	3.38
Aurora	3	86	11, 12	46	64.5	1.35	24	99	10	50	68.4	1.16
Louisville	21, 22	92	12	40	69.5	3.00	25	99	10	52	73.1	4.30
Golconda	17, 22	97	7	40	64.7	2.00	27	99	15	44	73.0	3.70
Belvidere	17	91	7, 9, 11	46	65.2	1.10	30	100	9	51	70.1	0.54
Ottawa	22	93	11	46	68.5	1.15	28	105	9	55	75.3	1.39
Decatur	18, 22	90	10	45	66.2	0.80	29	94	9, 12	54	73.0	1.50
Pana	22	90	12	46	67.0	0.90	24, 30	96	12	52	73.8	1.30
Winnebago	17	88	7, 10	45	65.4	1.25	24, 25	99	8, 11, 12	50	71.4	2.12
Rochelle	22	90	11, 12	43	63.4	......	27	100	11, 12	50	70.5	......
Wyanet	22	90	8, 10	40	65.0	1.42	24	104	7	46	73.0	0.70
Tiskilwa	3, 22	90	6, 13	44	65.4	......	24, 30	102	11	50	73.0	......
Hennepin, (S)	22	92	8, 10	40	61.0	......	24, 27, 29, 30	100	10, 12	46	71.0	......
Do (O)	22	93	10	44	63.6	......	30	104	10	47	74.3	......
Elmira	......	......	......	......	......	......	30	100	12	50	75.0	0.38
Peoria	22	92	10	45	68.3	1.62	30	100	9, 12, 13	56	74.6	0.75
Springfield	22	93	10, 12	46	67.9	......	30	103	8	52	75.9	......
Dubois	21	92	11	42	67.2	2.53	21	95	12	44	72.7	4.49
Galesburg	30	84	7	49	66.0	1.35	29	96	11	56	75.0	1.27
Manchester	16	86	12	45	66.2	1.59	25	99	11	50	75.2	2.60
Mt. Sterling	22	88	10	48	72.3	1.40	29, 30	95	......	......	82.7	......
Andalusia	22	86	28	46	65.8	......	27	98	9, 13	52	72.0	......
Augusta	3	87	10	47	64.5	1.73	30	99	11	51	73.2	2.35
Warsaw	3	94	10	48	67.1	1.97	30	100	11	53	72.2	2.89
Averages	......	......	......	......	65.5	1.52	......	......	......	......	72.7	1.97

Meteorology of 1870—Continued.

State and station.	May. Date.	May. Maximum temperature.	May. Date.	May. Minimum temperature.	May. Mean temperature.	May. Rain and melted snow.	June. Date.	June. Maximum temperature.	June. Date.	June. Minimum temperature.	June. Mean temperature.	June. Rain and melted snow.
WISCONSIN.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Sturgeon Bay	15	85	9, 24	43	59.4	2.40	24	94	10	49	69.1	2.20
Manitowoc	19	81	10	44	58.3	2.45	30	97	10	50	67.5	3.35
Hingham	16	87	7, 11	40	61.3	......	30	103	11	46	69.1	......
Milwaukee	3	88	8	41	59.4	0.63	30	100	11	45	67.8	2.62
Appleton	3	80	25	46	63.4	......	......	......	......	......	......	......
Geneva	16	90	7	45	64.4	0.20	24, 30	99	12	50	69.9	1.45
Waupaca	3, 15	87	25	47	65.1	......	30	100	9, 10	50	72.5	......
Embarrass	1	84	26	44	61.3	4.52	24,28,30	96	8	48	68.7	3.05
Rocky Run	17	88	10	46	65.5	2.50	30	99	9	49	72.4	1.06
Madison	17	85	10	45	64.7	1.09	30	98	10	52	71.3	1.92
Edgerton	30	96	10	48	68.4	0.50	30	102	8	52	74.6	3.50
Mosinee	3	86	8, 9	41	59.6	11.30	28	96	7	46	67.6	2.91
Baraboo	3	92	8	32	67.2	8.88	26	102	4	56	77.1	1.88
New Lisbon	3	90	9	46	64.1	......	23	104	11	49	71.4	......
Tunnel City	18	98	9, 10	46	......	5.88	29, 30	100	7	44	70.4	0.00
Bayfield	14	84	12, 16	38	54.6	......	23	100	11	40	......	......
Averages	......	......	......	......	62.4	3.67	......	......	......	......	70.7	2.39
MINNESOTA.												
Beaver Bay	18	83	22	38	50.4	1.34	19	93	6	43	59.3	2.59
Afton	17	88	9	46	66.1	5.20	29	99	7, 9	48	71.4	0.90
St. Paul	17	89	9	47	65.0	5.24	29	99	9	49	75.4	0.79
Minneapolis	3	91	9	44	62.8	3.95	29	96	7, 9	49	70.9	1.58
Sibley	3	85	10	43	69.1	2.78	27, 29	93	7	49	71.8	0.38
Koniska	27	85	24	40	61.9	3.20	26,28,29	94	7, 8	44	67.4	0.50
New Ulm	3, 17, 30	86	12	44	64.6	3.70	29	98	7	48	72.8	2.25
Madelia	30	90	9	44	66.1	5.61	26	100	7	49	74.8	0.40
Averages	......	......	......	......	63.3	3.88	......	......	......	......	70.5	1.17
IOWA.												
Clinton	21	86	10, 11	49	63.9	3.25	29	101	8, 9, 10, 11	50	70.2	2.75
Waukon	4, 17	86	10	43	63.1	......	29	96	8	46	69.2	......
Dubuque	3, 16, 17, 22	87	9	48	67.0	3.71	29	102	7, 10	56	74.5	0.46
Monticello	30	90	8, 9, 10, 11	50	67.8	4.11	27	102	9	35	72.4	1.60
Bowen's Prairie	16, 17, 30	88	8, 9, 10, 11, 12, 13	46	64.7	4.90	23	98	7, 8, 9	48	71.3	1.50
Ft. Madison	22	90	12	41	66.9	1.53	29, 30	100	10	52	76.0	1.12
Guttenberg	17	91	9	42	66.8	......	30	103	8	48	71.2	......
Mt. Vernon	3	87	12	44	65.6	......	30	98	7	48	70.6	......
Iowa City	21	89	10	44	65.5	3.00	30	99	8, 11	50	71.8	1.30
Independence	17	91	9	47	67.0	2.20	29	102	9	51	74.0	0.70
Near Independ'ce	4, 17	86	11	47	66.6	3.10	30	100	9	51	74.2	1.45
Waterloo	4, 15, 17	87	8	40	65.6	2.30	30	102	4	43	72.5	1.20
Rockford	15, 16, 17	85	10	45	66.8	......	29	93	9, 10	54	73.0	......
Iowa Falls	14, 16	88	12	44	69.8	4.43	29	96	9, 10	54	77.3	1.61
Algona	16, 17	83	7	43	62.6	......	26	94	11	50	70.2	......
West Bend	......	......	......	......	......	......	29	95	6, 8	48	71.9	......
Webster City	4, 30	85	9	41	64.5	2.08	29	94	8	48	70.9	0.50
Boonesboro	3, 15	85	9, 10	44	65.3	3.48	23, 26, 27, 28	96	8	46	70.5	0.48
Fontanelle	15, 17, 21	87	9, 10	45	65.7	3.25	29, 30	97	8, 9	52	74.1	1.25
Grant City	15	92	9	45	67.3	5.20	27	102	8	51	74.4	0.77
Sac City	15	85	8, 9, 10	46	63.8	......	......	......	......	......	......	......
Logan	4	85	12	39	64.2	2.00	29	98	10	43	69.3	0.30
Woodbine	17, 30	87	9, 24	42	64.9	4.06	30	100	7, 8, 9	48	70.6	0.22
West Union	17, 18, 19, 30	86	9, 10	46	66.2	2.42	30	101	8	53	73.4	1.03
Averages	......	......	......	......	65.7	3.18	......	......	......	......	72.3	1.08

Meteorology of 1870—Continued.

State and station.	MAY.						JUNE.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MISSOURI.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
St. Louis	21, 22	89	6, 7, 10, 11	50	67.9	2.05	30	94	9, 10	54	73.5	1.46
Allenton	21	96	10	44	67.0	2.57	29	99	11	51	71.9	4.88
Hematite	22	95	11	48	69.7	1.25	23	98	11	52	75.3	1.25
Hannibal	21, 22	88	10	48	67.7	1.30	30	98	10, 12	54	74.2	2.90
Rolla	21	91	10	43	69.2	0.68	30	96	11	51	73.9	2.73
Jefferson City	21	91	7	46	67.0	......	30	97	10	54	75.8	......
Kansas City	21	89	12	44	67.1	4.25	30	98	7, 9, 10	52	72.5	1.25
Harrisonville	21	90	6, 7	48	68.1	1.18	28	100	6, 7, 8, 9, 11, 12, 13	58	75.3	1.99
St. Joseph	21	89	6, 7	49	69.1	3.80	....	......	....	......	......	......
Oregon	21	89	6, 9	44	67.7	2.70	29, 30	98	9	51	73.4	1.27
Averages	....	......	....	......	68.1	2.20	....	......	....	......	74.0	2.22
KANSAS.												
Atchison	21	90	6	43	70.7	3.30	30	101	8	55	74.3	3.05
Leavenworth	18	90	6	45	67.3	6.16	30	102	12	53	73.6	1.95
Olathe	21	92	7	45	67.5	7.15	21	100	6	54	73.0	2.70
Paola	21	90	12	45	67.8	2.60	30	99	8, 9, 10, 11, 12	56	73.8	1.00
Baxter Springs	21	94	10, 11	50	71.7	2.80	1, 28	94	12	56	76.8	2.60
Lawrence	18, 21	89	6	45	68.0	2.46	30	101	7, 8, 9, 10, 11	56	73.7	1.88
Williamsburg	2	85	11	40	63.6	......	30	98	10	42	73.1	......
Holton	2, 21	91	6	46	69.0	3.44	30	106	6	53	74.6	1.19
State Agr'l Coll.	21	93	8	49	68.8	0.91	30	102	8, 9	55	74.6	0.79
Council Grove	18, 21, 28	90	8	46	69.1	2.30	30	100	12	52	76.6	2.50
Girard	31	87	5	43	67.8	4.15	21	95	11	56	74.2	5.85
Averages	....	......	....	......	68.3	3.46	....	......	....	......	74.4	2.35
NEBRASKA.												
Omaha Agency	14, 15	88	6	43	65.7	7.68	30	95	10	50	74.6	0.72
De Soto	2	86	10	43	65.0	4.95	29	101	8	49	74.0	0.89
Bellevue	4, 17, 21	85	6	48	67.5	5.80	29	96	8	53	74.2	2.10
Nebraska City	21, 28	89	6	43	67.8	2.80	29, 30	100	9	52	74.8	1.00
New Castle	18	94	12, 26	43	65.6	......	29	99	9	47	72.9	......
Averages	....	......	....	......	66.3	5.31	....	......	....	......	74.1	1.18
UTAH.												
G't Salt Lake City	13	85	31	42	59.4	0.60	27	95	1, 2, 17	45	66.5	......
Coalville	25	86	5	33	54.5	......	25	93	4	42	65.2	......
St. George	10	101	....	......	......	0.38	11, 25, 26	102	....	......	......	0.00
CALIFORNIA.												
Monterey	8	93	17	42	59.5	0.81	4	81	2, 18	44	64.3	0.00
Chico	7, 8, 9	98	17	40	68.2	0.75	30	104	15, 16	62	77.6	0.00
Watsonville	6	92	2	44	60.0	1.06	24	83	15, 16	48	62.5	0.00
Cahto	7	95	2, 13	41	60.3	2.25	6	95	29	50	66.7	0.02
Visalia	7	100	17	47	69.1	0.30	[illegible], 10, 11	94	1	59	75.9	0.00
Averages	....	......	....	......	63.4	1.03	....	......	....	......	69.4	0.01
MONTANA.												
Deer Lodge City	10, 11, 12	85	30, 31	32	51.8	3.55	28	98	1	35	61.7	3.85
COLORADO.												
Denver	14, 21	86	1, 5	40	56.1	0.35	29	94	3	48	63.2	0.52

Meteorology of 1870—Continued.

State and station.	MAY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	JUNE. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
WASHINGTON.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Port Angeles	23	62	2	44	52.5	4.49	9, 28, 29	69	15	49	58.0	5.00
Seattle	9	92	12, 14, 15	45	56.6	......	7	97	16, 17, 20	50	64.1	......
Cathlamet	9	80	15, 17	40	53.8	......	6	90	1, 22	48	60.4	......
OREGON.												
Portland	9	87	29	44	59.2	1.95	7	95	4, 15, 16, 20	53	65.5	1.95
Eola	8, 9	76	16	38	52.3	2.46	7	86	20	44	59.1	2.2

State and station.	JULY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	AUGUST. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MAINE.												
Houlton	24	99	2	55	73.2	4.00	11	93	27	46	68.3	4.00
Mt. Desert	......	......	......	......	......	......	10, 13	85	2	51	70.2	4.15
Orono	24	93	1	52	68.9	1.78	10, 18	87	27	44	66.7	3.21
Williamsburg	24	95	1, 29	54	69.3	2.47	9	87	26, 31	52	67.2	3.15
West Waterville	24	95	1, 4	58	73.9	1.29	9	95	26	52	70.1	1.90
Gardiner	24	89	4	55	71.5	2.43	9	84	16	53	68.4	1.99
Lisbon	23	94	4	53	71.4	3.27	10, 18	90	27	47	68.4	3.40
Norway	24	100	4	54	73.4	1.60	8, 9	90	26	53	69.2	1.65
Cornish	24	94	2, 4	56	71.9	2.74	9	92	27	47	69.5	3.55
Cornishville	24	96	1	57	74.0	3.25	9	92	27	52	71.7	4.70
Surry	......	......	......	......	......	......	10	91	27	45	69.7	......
Averages	......	......	......	......	71.9	2.54	......	......	......	......	69.0	3.17
NEW HAMPSHIRE.												
Stratford	24	98	1	52	69.1	2.47	7	89	27	40	65.1	3.86
Whitefield	24	92	1	50	71.0	2.47	19	89	27	38	67.7	3.98
Tamworth	24	97	1	53	72.8	1.62	9	96	27	48	69.8	2.45
Goffstown Center	23	100	1	56	75.4	1.87	9	101	27, 31	56	73.7	1.43
Averages	......	......	......	......	72.1	2.11	......	......	......	......	69.1	2.93
VERMONT.												
Lunenburg	24	89	2	56	72.6	4.56	9	90	26	48	67.8	6.42
North Craftsbury	24	89	1	48	69.6	2.86	9	91	26	43	64.5	4.62
Newport	......	......	......	......	......	......	9	94	27	46	67.7	4.15
East Bethel	24	93	2	50	74.1	2.11	9	97	27	42	67.3	1.36
Woodstock	18, 19, 24	87	1, 2	53	70.1	1.82	9	88	27	45	65.6	1.63
Near St. Albans	24	90	1	56	72.9	3.35	19	88	26	47	68.2	4.40
West Charlotte	24	96	1	57	76.7	3.41	7, 19	96	27	50	73.6	3.25
Panton	24	95	1	58	77.8	5.25	19	92	26	48	72.4	2.72
Castleton	24	94	2	55	74.5	2.89	8, 19	89	27	45	69.9	0.90
Averages	......	......	......	......	73.5	3.28	......	......	......	......	68.7	3.21
MASSACHUSETTS.												
Kingston	25	94	1	55	72.0	2.87	7	93	27	52	72.0	1.37
Topsfield	24	92	1	57	73.4	1.41	7, 20	91	27	54	72.0	5.27
Lawrence	24	95	1	57	74.4	1.55	7, 9	92	27	55	72.4	3.64
Newbury	29	98	1	56	76.0	......	......	......	......	......	......	......
Georgetown	......	......	......	......	......	......	8	97	27	49	73.5	7.33
Milton	24	97	2, 4	59	74.8	1.53	4	100	22	55	75.6	1.33
Cambridge	25	94	1	60	76.4	......	7	92	27	57	75.4	......
North Billerica	17, 24	92	1	58	74.7	......	7, 9	92	22, 27	53	73.3	......
West Newton	23, 24	100	3	52	77.4	1.42	7	100	26	57	77.1	0.56
New Bedford	25	89	3	56	70.9	2.98	5	86	27	53	70.6	1.65
Worcester	24, 25	90	4	60	73.0	2.39	7	88	27	53	71.7	2.74
Mendon	17, 23, 24, 26	88	1	59	73.2	2.65	7	90	28	56	72.2	1.75
Lunenburg	24	92	1	58	74.4	2.17	7	94	27	51	73.0	2.42
Amherst	17, 24	91	2	55	73.6	2.53	7, 9, 12, 19	91	27	47	71.1	2.88

Meteorology of 1870—Continued.

State and station.	JULY. Date.	JULY. Maximum temperature.	JULY. Date.	JULY. Minimum temperature.	JULY. Mean temperature.	JULY. Rain-fall.	AUGUST. Date.	AUGUST. Maximum temperature.	AUGUST. Date.	AUGUST. Minimum temperature.	AUGUST. Mean temperature.	AUGUST. Rain-fall.
MASS.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Richmond	17	91	2	58	74.1	4.25	......	......	......	......	......	......
Williams College	24	90	2, 4	54	72.2	3.89	9	94	27	44	69.1	5.77
Hinsdale	19, 23, 24	86	2	57	71.4	4.90	......	......	......	......	......	......
Averages	......	......	......	......	73.9	2.66	......	......	......	......	72.8	3.06
RHODE ISLAND.												
Newport	19, 25	88	3	55	67.1	3.06	5	84	27	55	75.2	2.49
CONNECTICUT.												
Columbia	17	98	1, 4	60	75.0	4.05	2	94	31	54	73.9	1.71
Middletown	18	95	4	55	74.3	1.54	7	97	27	48	73.2	3.14
Southington	17, 23	95	3	58	74.9	1.02	7	95	27	54	72.9	1.73
Colebrook	18, 19	91	9	56	72.8	3.77	7	90	27	51	70.3	2.73
Brookfield	17	95	4	56	74.8	3.40	2, 5	93	1, 26	60	74.7	......
Averages	......	......	......	......	74.4	2.76	......	......	......	......	73.0	2.33
NEW YORK.												
Moriches	26	93	3, 4	58	71.4	2.41	7	88	27	51	69.5	5.85
South Hartford	17, 24	94	2	52	77.6	3.70	19	93	27	52	75.8	1.45
Caldwell	17	89	2	58	74.1	3.00	8	87	27	53	71.0	6.55
Garrison's	17	94	3	59	75.5	2.97	6,7,9 19	90	27	54	73.0	1.91
Throg's Neck	17	92	3	59	75.9	......	2	88	14	60	75.1	......
White Plains	17	87	3	58	71.8	......	17	86	27	52	72.2	......
Cooper Union	17	95	3	63	77.9	4.72	7	89	28	63	77.3	3.79
Flatbush	17	97	3	59	81.6	2.81	2	90	27	57	75.5	3.06
Brooklyn	17	95	4	62	77.4	4.00	2	92	27	60	76.1	3.90
Glasco	17	99	1, 4, 5	60	75.0	1.50	18	93	15	50	70.0	4.40
Newburg	17	97	3	60	78.5	2.55	......	......	......	......	......	......
Minaville	24	97	4	56	75.5	3.65	19	94	27	49	74.6	2.30
Cooperstown	24	95	2	55	73.9	4.14	9	93	27	41	69.7	2.74
Gouverneur	24	90	1	56	71.9	2.37	19	88	27	44	68.3	1.87
North Hammond	19	99	1, 9	62	76.9	1.27	11	100	26, 27	54	76.3	2.06
Houseville	20	90	1, 8	55	72.8	3.95	6	89	26, 27	50	68.7	2.51
Leyden	20	88	1	55	70.2	3.09	......	......	......	......	......	......
Utica	19, 24	94	2	57	75.3	6.69	8	91	27	48	70.8	7.26
South Trenton	20	94	4	56	73.0	6.50	9	93	27	45	69.1	7.01
Cazenovia	20	90	30	58	72.0	......	8	88	27	45	68.3	......
Oneida	20, 24	94	1	55	78.0	6.73	25	93	26, 27	50	70.0	14.40
Depauville	19	89	1	56	71.2	1.58	8, 11	92	27	44	70.1	1.37
Oswego	20	85	1	57	71.4	4.72	6, 29	85	27	51	69.4	3.50
Palermo	24	92	1, 2	57	72.8	3.70	8	94	26	52	69.6	0.50
North Volney	4, 19, 23	89	1	56	74.0	......	8	94	26, 27	51	71.4	......
Waterbury	26	98	1, 3	54	72.4	......	7	95	26, 27	42	69.2	......
Nichols	20	97	3, 8, 22	57	73.8	......	25	96	27	44	70.7	......
Newark Valley	19, 23	94	8, 9	54	72.7	2.80	25	92	27	39	66.4	......
Himrods	17	86	1, 3	56	70.2	5.06	8	90	27	48	65.3	1.63
Rochester	23	87	15	58	72.6	4.72	8	91	27	52	72.1	3.26
Little Genesee	23	91	30, 31	52	69.7	8.86	6, 7, 18, 19	88	27	40	67.5	3.21
Suspens'n Bridge	17, 23	94	3, 9	56	72.1	4.25	8, 19	92	27	46	71.8	3.35
Lockport	23	87	1	58	71.2	2.79	8	89	27	51	70.3	2.52
Buffalo	6	90	1	58	72.4	3.10	7	97	27	46	71.7	1.58
Averages	......	......	......	......	73.9	3.84	......	......	......	......	71.1	3.68
NEW JERSEY.												
Paterson	17	98	3	61	77.6	3.82	11	95	27, 28	56	75.5	4.43
Newark	17	92	4	56	75.6	6.97	7	88	27	54	73.3	3.10
Trenton	17	97	3, 4	62	80.5	3.83	9	93	14, 27	60	78.3	3.93
Rio Grande	18	101	9	63	78.9	5.88	25	97	27	54	76.6	0.38
Moorestown	17, 18	93	2, 3	60	76.8	3.51	6, 25	92	27	58	74.5	3.69
New Germantown	17	94	3	58	76.0	5.74	25	95	31	52	73.9	2.38

Meteorology of 1870—Continued.

State and station.	JULY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	AUGUST. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
N. J.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Readington	17	96	3	60	76.6	......	7	94	16, 29	54	73.2	......
Haddonfield	17	95	2	59	77.0	3.61	6	97	27	58	74.5	4.72
Newfield	17	100	3	58	79.7	......	......	......	......	......	......	......
Greenwich	17	92	3	61	77.9	2.50	4, 6	89	27	60	75.5	9.84
Vineland	17	99	4	60	80.3	3.04	6	95	14, 27	62	76.9	8.15
Averages	......	......	......	......	78.1	4.32	......	......	......	......	75.2	4.51
PENNSYLVANIA.												
Nyces	19	92	8	54	72.3	2.50	18	89	21, 26	50	69.1	4.50
Hamlinton	23	94	3	56	76.8	3.60	6, 25	91	27	48	75.0	2.31
Fallsington	17	95	3	61	77.0	4.00	2, 3, 25	91	27	59	76.0	3.90
Philadelphia	17	95	3	61	80.1	3.50	3, 9	92	27	60	78.1	5.98
Germantown, (M)	17	97	4	62	77.7	......	25	94	27	60	77.1	......
Do ......(T)	17	94	3	63	78.7	......	6, 9, 25	91	16,27,28	63	76.0	3.08
Horsham	17	91	3	58	75.4	6.21	3, 9, 25	89	27	58	73.3	4.13
Plymouth Meeti'g	16, 17	93	3	60	76.5	5.21	9, 25	89	27	58	73.5	5.06
White Hall	16, 17	92	31	57	78.2	......	7	92	27	50	74.1	......
Factoryville	24	94	3, 4, 7, 9	60	73.7	5.28	6, 25	92	27	44	70.0	1.82
Reading	17	94	3	62	77.8	3.74	25	91	27	59	75.1	5.58
West Chester	......	......	......	......	......	......	6	94	27	57	73.6	7.76
Parkersville	17, 25	94	3	61	78.9	3.35	6	94	21, 23	63	76.2	8.15
Tamaqua	17	92	10	51	71.0	3.20	25	90	26, 27	44	......	......
Catawissa	17, 18, 20, 23	93	3	54	73.3	......	6	94	22	50	72.6	......
Ephrata	17	98	2, 3, 4, 10, 11	62	76.8	3.83	25	92	14	59	74.7	3.65
Mount Joy	16	98	4	61	79.5	......	......	......	......	......	......	......
Harrisburg	17	99	2	64	80.1	2.36	......	......	......	......	......	......
Carlisle	16, 17	98	3	59	77.2	5.90	6, 7, 8	93	22, 27	58	74.2	2.80
Fountain Dale	17	94	3	59	77.0	3.66	25	90	14, 27	59	73.8	3.41
Tioga	20, 23	96	9, 11, 22	56	73.5	6.75	8	94	27	38	69.4	4.05
Lewisburg	17	94	3	58	76.2	3.99	7, 25	91	27	53	71.4	2.67
Grampian Hills	23	93	3,8,9,30	56	70.9	6.63	6, 7, 8, 9	90	31	46	68.6	3.23
Johnstown	24	92	9	54	73.5	4.47	7	90	15, 21	51	69.9	7.93
Franklin	23	95	9	54	73.0	11.68	8	93	27	48	69.9	5.96
Pittsburg	24	92	9	58	75.7	6.10	......	......	......	......	......	......
Greencastle	17	99	3	61	85.3	3.20	8	97	16, 22	58	78.3	6.10
Connellsville	23	98	8	60	77.8	......	8	97	21	54	73.9	......
Brownsville	20,23,27	92	30	64	81.0	......	5, 8, 25	92	6, 15, 16, 17, 22, 23, 30	64	79.0	......
New Castle	24	91	9	53	74.9	7.50	9	87	27	47	72.0	6.90
Beaver	17	92	9	58	74.1	......	8, 24, 25	88	21	54	71.6	......
Canonsburg	17, 20, 23, 24	93	9	56	74.6	3.46	7, 8	91	16,23,31	53	71.8	3.81
Averages	......	......	......	......	76.4	4.79	......	......	......	......	73.5	4.67
DELAWARE.												
Milford	27	96	2, 3	62	79.6	4.30	3	95	27	59	82.4	3.30
Dover	......	......	......	......	......	3.70	4, 25	92	23	64	79.4	3.85
MARYLAND.												
Woodlawn	17	95	3	58	77.9	4.17	2, 20, 25	90	27	58	76.0	3.83
Annapolis	17	98	3	64	81.2	5.41	25	92	23, 27	65	78.7	1.77
Mt. St. Mary's	25,26,27	91	3	59	76.0	3.50	3, 8, 25	87	27	58	72.7	3.28
Averages	......	......	......	......	78.4	4.36	......	......	......	......	75.8	2.96
DIST. COLUMBIA.												
Washington	17	94	9	67	79.5	4.80	4	89	27	63	76.9	2.05

Meteorology of 1870—Continued.

State and station.	JULY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	AUGUST. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
VIRGINIA.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Johnsontown	18	94	4, 8	67	79.5	3.40	25	95	23	64	77.7	0.45
Hampton	18	100	8	67	81.4	2.55	25	98	23	64	79.0	2.35
Zuni Station	16	98	4, 8	72	83.1	1.78	......	......	......	......	......	......
Surry C. H.	18, 25	100	30	70	85.4	2.40	10, 25	100	23	65	81.9	2.00
Comorn	18	94	3	66	79.7	2.97	25, 29	90	27	64	78.2	0.81
Vienna, (W)	17	93	2, 3	63	77.4	7.70	25	90	27	57	75.1	1.50
Fairfax C. H.	16	107	8	59	82.3	6.40	25	95	23	59	74.1	......
Piedmont	17, 28	96	9, 30	64	77.7	0.85	2, 7, 25	92	14, 21	61	83.8	2.75
Piedmont Station	17, 28	95	3, 11	62	76.6	0.80	25	93	16, 22	60	74.7	2.35
Staunton	17, 28	89	31	64	75.1	4.33	25	87	21, 22	61	72.4	2.74
Lexington	17	99	8, 9, 10	66	79.5	4.56	10	98	23	60	77.2	3.15
Lynchburg	17	91	10	66	78.5	......	25	90	23	64	76.3	1.25
Near Wytheville	28	86	9	57	74.1	2.50	7, 8, 25, 28	84	16	62	72.3	7.60
Averages	......	......	......	......	79.3	3.35	......	......	......	......	76.9	2.45
WEST VIRGINIA.												
Romney	17	102	31	66	81.8	......	8	100	21, 22	60	77.7	......
Weston	1, 6, 22, 23, 24, 27, 28	90	31	59	75.4	......	9	92	21, 22	58	72.7	......
Cabell C. H	16, 27	98	31	56	78.1	7.30	......	......	......	......	......	......
NORTH CAROLINA.												
Goldsboro	28	101	9	72	84.4	12.25	20, 26	99	16	65	82.3	6.95
Warrenton	1	94	9	68	81.5	5.80	12	86	16	62	76.5	5.60
Oxford	1	96	9	68	80.2	5.95	......	......	......	......	......	......
Albemarle	2, 18, 29	98	10	61	81.1	3.51	26	100	23	58	78.3	2.13
Statesville	1	94	9	60	76.8	7.50	26	94	16	58	74.8	3.75
Asheville, (A)	28	87	9	59	73.8	6.40	26	85	16	63	72.4	5.60
Do (H)	12	84	9	56	72.4	......	20, 25, 26	82	16	62	72.0	......
Averages	......	......	......	......	78.6	6.90	......	......	......	......	76.1	4.81
SOUTH CAROLINA.												
Bluffton	28	98	21	75	84.8	2.00	8	93	2, 3	75	83.0	6.10
Gowdeysville	1, 2, 15	94	8, 10	74	82.3	5.74	25, 26	91	16	68	81.3	1.75
Aiken	26, 28	96	30	70	82.7	2.36	20	93	14, 31	70	78.8	3.22
Averages	......	......	......	......	83.3	3.37	......	......	......	......	81.0	3.69
GEORGIA.												
Berne	19, 20, 28	94	14, 21, 31	74	81.5	1.68	3	90	25	68	78.5	1.45
St. Mary's	19	94	5, 14, 15	74	81.5	......	5, 16, 18	90	24, 25, 26	72	81.1	......
Penfield	28	98	8	66	82.0	1.95	26	96	17, 31	71	80.2	2.09
Averages	......	......	......	......	81.7	1.82	......	......	......	......	79.9	1.77
ALABAMA.												
Rockville	14	98	8	70	83.7	6.13	8, 25, 27, 28	91	2	70	81.2	4.43
Carlowville	2, 7, 12, 28	96	15, 17, 23, 30	74	84.2	3.50	25	98	31	72	82.3	8.21
Greene Springs	14	95	9	64	79.9	7.38	29	91	1	70	80.6	2.55
Coatopa	27	96	8, 9	68	81.0	5.40	28	97	30	72	78.1	2.50
Fish River	6, 15	91	9	72	......	......	......	......	......	......	......	......
Averages	......	......	......	......	82.2	5.60	......	......	......	......	80.6	4.42
FLORIDA.												
Near Port Orange	20, 26	89	3, 5, 6, 14, 15, 22	72	79.2	4.80	14	88	4	73	80.6	2.03

Meteorology of 1870—Continued.

State and station.	JULY.						AUGUST.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
FLORIDA—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
St. Augustine....	3, 13, 18	92	14	72	81.5	2.50	17	94	1, 10, 12, 21	76	85.3	0.40
Jacksonville.....	19, 20	97	4, 14, 16	76	84.1	2.65	3, 10, 30	94	24, 26	77	84.4	4.40
Pilatka..........	3, 4	98	4, 5, 6, 8	74	82.4	4.16	1, 2, 7, 11, 12, 20, 28	96	25, 26, 31	72	82.3	1.13
Manatee..........	18	94	23	74	83.1	11.00	......	......	......	......	......	......
Orange Grove....	18, 20, 26	92	31	73	82.1	9.55	20	94	11	76	82.6	7.05
White Spring..	10, 13, 28, 29, 30, 31	96	19, 25	73	84.4	......	......	......	......	......	......	......
Newport..........	27, 31	91	9	70	79.9	2.77	9, 19	93	2, 8, 12	73	80.2	2.65
Chattahoochie ...	11, 12	96	6	72	86.1	3.20	9	95	24	70	84.0	5.50
Averages....	......	......	......	......	82.5	5.08	......	......	......	......	82.8	3.32
TEXAS.												
Clarksville.......	2	93	9	72	83.0	......	21	88	31	70	82.3	......
Gilmer............	16, 17, 18	98	8	71	83.0	9.30	3	97	31	66	82.5	5.42
Oakland	7, 29	98	31	72	83.7	1.87	16	96	7	74	82.6	4.44
Blue Branch, (W).	18	94	10	67	80.2	1.70	21	96	4	72	86.3	1.70
Do ......(G).	7, 17	95	7	72	80.8	2.70	......	......	......	......	......	......
Lavaca	7, 8, 10, 11, 12, 13, 17	93	21, 26, 30, 31	76	83.2	5.90	16	96	1	78	84.0	1.90
Bluff..............	11, 16, 17	95	22, 29	74	82.9	4.95	22, 23	94	1, 2, 7, 10	76	82.8	1.98
Clinton	7, 8, 13, 16, 17, 18	96	29	70	82.4	5.75	21	94	3	70	80.7	2.45
Austin..........	3, 7, 13, 14, 15, 16, 17	95	8, 31	71	82.2	2.04	22	96	26, 31	72	......	......
Lockhart	16, 17	95	26	74	83.8	4.50	21, 22	92	30, 31	74	81.6	......
San Antonio	17	101	4	71	79.8	3.72	2	99	31	73	82.6	6.48
Averages....	......	......	......	......	82.3	4.25	......	......	......	......	82.9	3.48
LOUISIANA.												
New Orleans.....	9	93	25	71	79.8	6.00	20	92	31	73	80.6	5.40
Shreveport.......	13	94	9	73	83.4	......	20, 23	92	30	70	81.2	......
Near Cheneyville.	15	93	2, 19	73	81.2	......	21, 22	91	20, 31	74	82.0	......
ARKANSAS.												
Helena	16	94	8	68	81.8	......	13, 19, 28	90	30	69	81.4	......
Mineral Springs..	......	......	......	......	......	......	3	92	31	60	78.1	4.63
MISSISSIPPI.												
Columbus........	14	97	9	68	82.1	4.66	10, 27, 29	92	31	69	80.7	5.81
Enterprise.....	8, 10, 12, 13	101	10, 11, 17, 25, 28	73	86.5	3.30	18	101	1	72	95.9	2.50
Philadelphia	13, 14, 15	94	8	68	79.9	4.60	19, 20	92	1, 6	70	71.7	2.90
Grenada	16	95	5, 9	65	80.2	7.55	10, 19, 25	94	31	62	79.2	3.85
Brookhaven	16	95	25	70	81.1	5.20	20	91	31	70	77.7	5.40
Near Br'khaven	1, 11, 12, 13, 15	98	25	68	81.1	9.20	26	95	31	70	80.0	9.10
Holly Springs....	25, 27, 29	94	16	61	79.9	0.90	......	......	......	......	......	2.20
Averages....	......	......	......	......	81.5	5.06	......	......	......	......	80.9	4.54
TENNESSEE.												
Elizabethton.....	15	94	9	58	77.2	2.71	8, 25, 26	92	16, 23	64	76.7	4.09
Tusculum College	26	90	8	62	78.2	......	......	......	......	......	......	......
Knoxville........	23	91	7	65	78.3	3.50	25	91	31	66	76.7	3.85

Meteorology of 1870—Continued.

State and station.	JULY. Date.	JULY. Maximum temperature.	JULY. Date.	JULY. Minimum temperature.	JULY. Mean temperature.	JULY. Rain-fall.	AUGUST. Date.	AUGUST. Maximum temperature.	AUGUST. Date.	AUGUST. Minimum temperature.	AUGUST. Mean temperature.	AUGUST. Rain-fall.
TENN.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Lookout Mount'n.	25, 27	93	8	70	80.5	......	26	91	1, 16, 17, 31	72	78.7	......
McMinnville.....	27	92	8	62	76.3	......	8, 25, 27	[illegible]	31	65	75.2	......
Austin...........	27	92	7	64	78.4	7.08	8, 23, 24, 26	90	30	58	79.0	4.66
Clarksville.......	16	83	9	62	76.0	5.97	23	88	31	62	74.8	4.28
Trenton	27	96	8	62	80.8	1.80	7, 8	95	30, 31	60	79.2	3.40
La Grange	15	99	7, 8	71	83.5	1.90	12	94	31	66	79.5	5.00
Averages....	......	......	......	......	78.8	3.83	......	......	......	......	77.5	4.11
KENTUCKY.												
Pine Grove	17, 18, 21, 25, 28	92	30	62	77.5	4.85	6, 7, 8, 24, 25	90	21, 31	60	74.2	4.84
Shelby City......	17	92	8	66	78.7	5.66	......	......	......	......	......	......
Near Louisville..	27	96	8, 30	57	78.9	3.28	8, 25	96	30	52	76.7	2.22
OHIO.												
Salem............	16, 24	92	8	60	75.8	3.17	8	92	27	56	74.6	4.20
Steubenville	17	92	9	60	77.2	4.83	25	89	21	56	74.4	2.82
Painesville	17	90	2	57	71.2	12.13	9	87	27	50	70.8	3.19
Gilmore	17	103	2	63	74.7	2.60	7, 8, 9	100	13, 14, 20	58	75.2	2.30
Milnersville	20	93	9, 11, 30	60	75.7	4.90	6, 8	92	22, 31	50	71.7	3.60
Cleveland........	23	91	3	56	72.3	10.15	19	89	26	50	70.3	2.00
Wooster, (W)	17	100	8, 29	64	78.9	......	24	98	30	54	75.8	......
Do...(H)	17	101	4	61	75.4	......	8	101	22, 27, 30	59	76.9	......
Pennsville	18, 28	96	8	61	80.6	3.75	6	93	27	54	74.5	2.10
Gallipolis	27, 28	96	9	58	78.4	2.99	8	96	17, 22	58	75.0	5.23
Adams' Mills	17	94	9	59	77.8	3.79	8	94	22	55	75.0	2.58
Oberlin	16, 17, 23	96	2	56	74.1	8.90	7, 24	92	27	50	71.2	1.55
Kelley's Island...	23	92	2, 30	64	76.6	6.32	24	88	26	58	75.5	1.52
Sandusky	17	93	8, 9	62	75.4	5.28	23	91	26	53	73.3	1.72
Carson............	......	......	......	......	......	......	24	92	26	56	74.7	2.10
North Fairfield ..	17	93	9	59	74.5	4.47	24	92	27	52	72.9	1.25
Gambier..........	27	90	30	58	73.6	4.12	......	......	......	......	......	......
Westerville......	25, 27	98	8, 29	58	77.2	3.33	8	96	22	56	74.3	1.83
North Bass Island	20	96	8	61	75.5	7.00	18	92	26	60	75.2	1.37
Marion	26	94	8	59	76.2	2.43	21	93	21, 27	55	72.8	1.70
Hillsboro	24, 27, 28	90	8, 30	59	75.5	2.83	8	90	21	56	72.6	3.54
Bowling Green...	17	101	29	57	78.0	6.55	24	96	20	51	75.1	3.85
Kenton	20, 23, 25	104	15, 30	70	84.2	3.63	8	[illegible]	22, 27	68	77.1	1.90
Bellefontaine	......	......	......	......	......	......	6	92	12, 25	59	72.9	3.40
Urbana Univers'y	27	95	29, 30	69	76.3	2.63	24	95	22, 23	58	73.1	2.34
Springfield	24, 27	95	29, 30	65	78.9	3.10	......	......	......	......	......	......
Bethel	17, 23, 24, 27	94	30	56	77.1	3.25	8	94	20, 30	58	74.7	3.63
Jacksonburg.....	17	94	8, 29	62	77.4	6.65	6	92	21	58	74.7	2.20
Mt. Auburn Sem.	27	95	8	66	80.4	2.38	24	93	26	61	77.0	0.56
Cincinnati, (P)...	17	100	30	65	82.7	3.21	7	95	16, 21, 27, 31	61	77.5	1.10
College Hill......	17, 27	97	8	65	84.0	1.88	8, 24	97	21	62	78.7	1.66
Averages....	......	......	......	......	77.1	4.68	......	......	......	......	74.4	2.39
MICHIGAN.												
Detroit	20	94	8	58	74.1	6.21	1, 6	91	26, 27	55	72.5	2.20
Monroe City	5	99	29	62	78.3	9.13	24	98	13, 26	60	77.5	2.20
Ann Arbor	17	94	8	57	74.3	6.36	24, 28	90	13, 20, 26, 27	56	70.8	1.36
Alpena	25	83	1, 8	56	67.2	3.29	4, 17	82	26	50	66.4	2.57
State Agr'l Coll..	16	93	2	59	74.4	8.02	1, 5, 6	90	27, 30	51	70.1	4.53
Litchfield	17	90	8	56	71.7	7.63	24	89	14	59	69.5	1.86
Cold Water	22	94	8	53	73.1	4.25	24	92	27	45	69.0	1.41
Grand Rapids, (H)	23	99	7	58	76.6	0.76	24	90	20	50	74.3	1.67

Meteorology of 1870—Continued.

State and station.	JULY. Date.	JULY. Maximum temperature.	JULY. Date.	JULY. Minimum temperature.	JULY. Mean temperature.	JULY. Rain-fall.	AUGUST. Date.	AUGUST. Maximum temperature.	AUGUST. Date.	AUGUST. Minimum temperature.	AUGUST. Mean temperature.	AUGUST. Rain-fall.
MICH.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Grand Rapids, (S)	23	92	8	57	73.1	5.55	24	87	19	53	68.2	2.04
Northport	10	86	2, 13, 14	54	68.5	10.88	11	82	26	50	66.1	6.13
Pleasanton	23	88	7	52	69.4	9.50	2	90	26, 27	48	65.1	4.85
Muskegon	15, 17, 21	98	8	58	79.4	0.50	24	90	27	52	73.7	5.00
Otsego	22	105	31	50	74.1	......	23	108	31	53	68.2	......
Copper Falls	18	86	1, 13, 29	50	61.5	2.00	2	79	11	47	61.1	3.41
Ontonagon	15, 16	90	5, 6, 7	56	69.0	......	3, 4	78	11, 19, 31	54	62.6	......
Averages	....	......	....	......	72.0	5.70	....	......	....	......	69.0	3.02
INDIANA.												
Aurora	1, 15, 24, 25	100	30	60	79.0	3.07	8	100	30	56	76.5	1.65
Vevay	27	93	9	61	77.9	3.20	8	94	30, 31	59	75.4	2.55
Mount Carmel	17, 24	96	29	61	77.7	3.04	24	94	14, 21	60	75.2	1.55
Spiceland	27	96	8	61	78.3	3.15	24	95	20, 21, 26, 27, 29, 30	60	73.9	1.55
Laconia	27	95	8	66	78.1	3.80	24	92	30	60	75.0	4.71
Columbia City	27	96	30	58	77.2	5.56	24	94	27	52	74.0	2.38
Knightstown	27	98	8	61	79.0	1.16	24	96	30	57	67.3	1.77
Warsaw	17, 19, 20, 27	90	2, 8, 21, 30	70	79.8	5.65	....	......	....	......	......	1.40
Indianapolis	26	92	30	61	77.4	2.84	24	89	21	58	72.8	2.97
Near La Porte	25	98	2, 7, 29	62	77.3	5.23	24	96	26	56	72.9	1.83
Rensselaer	25	98	7	60	79.0	5.10	24	94	13	55	73.5	2.80
Merom	24	98	8	62	83.1	1.60	....	......	....	......	......	......
New Harmony	1, 18, 21, 23, 27	93	8	66	80.5	7.00	8, 24	92	31	63	76.5	5.17
Harveysburg	21	96	8	58	72.0	3.70	7, 23, 24	90	13	50	70.6	3.00
Kentland	20, 27	91	2, 4, 9	60	73.2	3.50	....	......	....	......	......	......
Averages	....	......	....	......	78.0	3.84	....	......	....	......	73.6	2.58
ILLINOIS.												
Chicago	24	100	8	61	78.9	3.71	24	96	19, 20, 30	60	75.0	2.07
Near Chicago	22	100	7	60	79.0	......	24	98	13, 19	56	74.1	......
Evanston	22	94	2	56	75.1	4.26	24	92	13	58	71.1	2.28
Marengo	19	96	8	53	74.2	4.66	24	92	20	48	68.6	3.79
Charleston	27	94	30	63	78.2	4.40	1	92	13	56	72.0	4.34
Mattoon	21, 25, 27	92	30	60	78.8	2.38	24	90	13	58	73.7	3.81
Aurora	4, 22	95	7	57	76.2	5.50	24	92	13	51	69.9	3.31
Louisville	21	98	4	62	80.8	6.30	20	98	30	60	75.7	5.10
Golconda	18, 22	102	9	52	80.5	1.50	4	100	15	60	82.8	2.50
Belvidere	26	94	30	59	75.2	4.40	24	95	20, 27	53	69.7	2.61
Ottawa	25	105	2	60	83.4	1.90	24	99	13	55	72.6	2.26
Decatur	20, 21	98	30	61	78.9	1.50	1	92	13	55	72.6	4.00
Pana	21	94	30	62	78.5	3.50	1, 24	89	13	59	73.0	4.80
Winnebago	19	95	8	57	76.1	3.74	24	93	19	51	70.2	3.74
Wyanet	25	105	30	52	84.9	1.91	....	......	....	......	......	......
Tiskilwa	17, 25	102	7, 30	58	78.6	......	....	......	....	......	......	......
Hennepin, (S)	25	102	30	52	78.0	......	1, 24	94	14, 20	50	71.0	......
Do....(O)	17	105	30	54	80.1	0.00	1	97	14, 20	53	74.1	1.25
Elmira	16, 20	109	7	58	80.1	0.66	5	93	13	52	71.0	3.15
Peoria	25	101	30	61	81.3	0.68	24	94	13	56	74.0	3.26
Springfield	22, 25	102	1, 8	64	81.7	......	24	95	25, 26	60	74.7	......
Dubois	21	101	30	61	79.0	2.12	6, 24	94	4	59	76.9	3.23
Galesburg	20, 21, 25, 26, 27	96	7	61	80.0	1.10	23, 24	89	13, 26	58	72.0	3.70
Manchester	22	101	7	60	79.7	4.55	1	97	30	54	73.3	5.22
Mt. Sterling	14	95	7	66	82.8	3.50	23	89	13	55	73.5	5.00
Andalusia	19, 22	98	30	54	79.0	......	24	87	26	53	70.9	......
Oquawka	20	103	8	59	80.6	2.70	5, 24	94	13	55	73.5	4.98

Meteorology of 1870—Continued.

State and station.	July. Date.	July. Maximum temperature.	July. Date.	July. Minimum temperature.	July. Mean temperature.	July. Rain-fall.	August. Date.	August. Maximum temperature.	August. Date.	August. Minimum temperature.	August. Mean temperature.	August. Rain-fall.
ILLINOIS—Cont'd.												
		Deg.		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Augusta	17,19,20	95	7	59	79.5	2.01	5, 21	88	13	53	72.6	5.41
Warsaw	16,25,27	100	30	62	79.4	1.38	4	97	13	54	71.2	5.23
Averages	......	......	......	......	79.3	2.85	......	......	......	......	73.0	3.72
WISCONSIN.												
Sturgeon Bay	10,16,26	87	13	54	71.4	5.30	4	85	26	55	67.6	5.25
Manitowoc	26	93	7	54	70.6	4.20	4, 17	87	20	52	67.8	5.73
Hingham	26	92	8	54	71.9	......	24	92	15, 27	54	69.6	......
Milwaukee	26	96	30	52	72.4	4.64	24	92	27	49	69.0	2.69
Geneva	23	96	30	58	74.1	3.23	24	97	20	53	70.1	2.35
Waupaca	22	95	1, 6, 7, 8, 13, 14, 15, 28, 29	60	73.1	......	1, 4, 18	89	19	52	64.5	......
Embarrass	18, 22	92	2, 8, 31	52	70.5	8.53	18	86	26	46	65.3	9.86
Rocky Run	23, 26	91	29	58	77.5	7.00	24	90	13, 20	53	68.4	6.63
Madison	23, 26	91	7	58	73.8	5.25	24	89	20	56	67.1	3.65
Edgerton	18, 22	100	8	59	77.2	6.80	24	96	20	50	72.0	4.30
Mosinee	18	93	7	52	69.3	16.32	4, 18	87	20	35	63.3	15.65
Baraboo	3, 19, 22	98	2, 7	60	76.2	3.63	4	96	13, 26	54	71.1	6.87
Tunnel City	3	93	4	50	69.9	10.30	24	92	19, 20	48	67.8	11.70
Bayfield	24	98	3, 29	54	69.7	......	15	86	20	50	64.3	......
Averages	......	......	......	......	72.7	6.84	......	......	......	......	67.7	6.79
MINNESOTA.												
Beaver Bay	22	94	10	50	64.5	3.18	4	88	19	46	60.9	1.93
Afton	19	96	7	58	72.9	6.23	......	......	......	......	......	......
Minneapolis	23	96	29	56	72.9	3.85	1	90	19	46	65.5	6.02
Sibley	19	97	8	55	73.1	1.74	......	......	......	......	......	......
Koniska	12	89	28	54	69.4	3.30	......	......	......	......	......	......
Litchfield	19	94	6	56	72.7	2.50	4	90	20	43	65.4	3.70
New Ulm	19	100	6, 30	58	75.5	2.44	4	100	12	46	67.6	6.95
Madelia	19	99	6	55	77.9	3.05	22	95	19	44	68.8	2.95
St. Paul	19	95	7	59	73.7	3.13	1	90	12, 19	50	66.1	8.56
Averages	......	......	......	......	72.5	3.27	......	......	......	......	65.7	5.02
IOWA.												
Clinton	26	97	12	58	77.9	3.00	24	94	14, 26, 30	56	72.1	3.20
Waukon	19	93	7	55	......	......	......	......	......	......	......	......
Dubuque	25	100	30	58	77.9	1.83	5, 24	95	20	51	70.8	4.30
Monticello	25	101	7	59	78.2	5.25	5	98	20	50	70.4	3.65
Bowen's Prairie	3	98	6, 7, 12	58	74.8	5.00	5	96	12, 20	50	70.2	3.00
Ft. Madison	19	105	30	63	82.0	1.60	5, 23	91	13, 26	52	72.0	6.50
Guttenberg	26	99	30	50	74.1	......	22	99	20	43	67.8	......
Mt. Vernon	19,23,25	98	8, 12	54	75.8	......	24	95	20	49	69.6	......
Iowa City	22, 23, 24, 25, 26	100	7	55	78.3	1.85	2, 5, 24	96	20	50	70.9	5.83
Independence	19, 22, 23, 25, 26	99	7	59	78.0	6.23	5	97	19, 20	51	70.2	4.13
Near Independ'ce	26	98	7	60	77.9	6.60	24	97	19	52	71.0	5.30
Waterloo	26	101	29	54	78.4	1.20	4, 5, 24	98	19, 25	50	72.2	7.50
Rockford	19,22,23	92	6	64	77.2	......	18, 24	90	20	46	68.0	......
Iowa Falls	......	......	......	......	......	......	5, 23	90	26	40	67.3	5.18
Algona	26	97	6	55	75.0	......	22	89	19	43	67.1	......
West Bend	26	98	6	52	75.7	......	18	92	20	44	66.2	......
Webster City	24	100	7	55	76.6	1.07	......	......	......	......	......	......
Boonesboro	15	99	7	57	77.9	3.06	2, 5, 24	90	19, 26	42	66.3	6.12
Fontanelle	24	100	7	59	79.4	2.56	5	95	19	47	69.8	13.00
Grant City	12	104	6	57	80.5	2.12	18, 22	98	19	47	70.7	2.60
Logan	15, 23	96	7, 8	54	75.8	7.00	2, 23, 31	87	19	42	66.5	1.80

Meteorology of 1870—Continued.

State and station.	JULY. Date.	JULY. Maximum temperature.	JULY. Date	JULY. Minimum temperature.	JULY. Mean temperature.	JULY. Rain-fall.	AUGUST. Date.	AUGUST. Maximum temperature.	AUGUST. Date.	AUGUST. Minimum temperature.	AUGUST. Mean temperature.	AUGUST. Rain-fall.
IOWA—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Woodbine	4	102	7	56	77.6	4.31	2	94	19	43	67.5	1.29
West Union	22	98	30	60	77.3	6.80	21	94	20	50	70.7	6.01
Averages					77.4	3.72					69.4	4.96
MISSOURI.												
St. Louis	22,25,27	94	3	62	76.8	1.81	24	93	14	61	75.5	6.05
Allenton	27	100	8	57	77.6	3.67	6	98	30	53	73.5	5.99
Hematite	21	100	8	62	80.4	4.41	11	96	30	59	77.0	4.56
Hannibal	22	95	7	59	79.5	6.00	5, 23	90	13	54	73.0	6.70
Rolla	22	97	7	61	79.8	3.99	6, 24	92	29	63	78.6	5.64
Jefferson City	17	98	7, 9	64	80.0	......	5	96	13, 30	60	76.7	......
Kansas City	17, 20, 24	96	7	60	79.2	3.75	6	95	13	54	74.1	5.83
Harrisonville	4	100	6, 7, 9	64	80.7	2.09	4, 5, 6	98	13, 14	56	73.9	7.49
St. Joseph	......	......	......	......	......	......	5	95	13	54	74.7	8.30
Oregon	15, 22, 24	98	7	57	80.3	0.76	2, 5	96	19	50	71.8	8.41
Corning	......	......	......	......	......	......	5	98	19	49	72.6	4.40
Averages					79.4	3.31					74.7	6.34
KANSAS.												
Atchison	20, 26	100	7	61	81.8	2.05	5	101	13, 19	53	73.1	13.10
Williamstown	......	......	......	......	......	......	5	95	13, 19	54	76.3	8.55
Leavenworth	17	100	7	58	79.8	3.12	5	99	12, 13, 19	51	72.4	9.21
Olathe	17	102	7	60	79.6	6.55	1, 2	100	13	53	74.7	7.75
Paola	17	100	7, 8	62	80.6	3.10	5	101	13	55	74.7	8.36
Baxter Springs	1, 5	99	7, 8	72	84.9	3.00	3	100	25	64	88.8	9.50
Lawrence	17	99	7	60	80.3	5.58	3, 5	98	13	53	73.5	6.69
Williamsburg	17	99	7	51	77.4	......	2	99	19	51	73.3	......
Holton	24	106	6	62	84.4	1.00	2, 5	102	19	52	73.1	11.13
State Agr'l Coll	14, 15	102	10	65	84.9	2.98	5	99	19	52	72.9	5.21
Council Grove	13, 14, 17	100	7	60	82.7	1.90	2	102	19	52	75.4	5.70
Douglass	24	99	......	......	......	......	4	104	19	53	75.6	9.20
Averages					81.4	3.25					75.3	8.58
NEBRASKA.												
Omaha Agency	26	102	6, 29	59	80.0	2.31	22	93	19	50	69.4	1.53
De Soto	......	......	......	......	......	......	23	94	12, 19	49	69.3	2.39
Bellevue	26	96	6, 7	62	82.1	2.00	2, 5	91	19	50	69.9	3.60
Nebraska City	15	98	7	60	79.3	2.63	5	96	19	48	70.4	4.10
Newcastle	14, 19, 22	102	29	61	79.8	0.00	4	100	19	50	69.7	0.00
Averages					80.3	2.32					69.7	3.80
UTAH.												
Salt Lake City	12	96	16, 17	68	76.0	......	1	92	25	51	71.2	......
Coalville	21	95	10	55	72.5	0.00	3, 4, 9	90	25	42	68.2	0.00
CALIFORNIA.												
Monterey	2, 3	90	8	55	64.4	0.00	3	90	29	51	67.8	0.00
Chico	3	116	15	66	86.7	0.00	3	116	19	69	82.2	0.00
Watsonville	1, 2	98	30	58	67.0	0.00	22	85	23	56	67.0	0.00
Cahto	3, 4	106	14	57	78.0	0.00	3	108	24	50	74.5	0.00
Visalia	3	108	16	70	85.4	0.00	4	105	27	61	82.6	0.00
Averages					76.3	0.00					74.5	0.00
MONTANA.												
Deer Lodge City	27, 28, 29	89	26	48	67.0	0.28	3, 4	88	18	32	56.4	0.63

Meteorology of 1870—Continued.

State and station.	JULY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	AUGUST. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
COLORADO.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Denver	18	98	6	53	74.2	0.51	2	97	11	45	64.8	0.12
WASHINGTON.												
Port Angeles	5	88	18	54	62.4	0.84	6	73	20, 21, 23, 25	54	60.2	3.40
Seattle	6	104	15	56	74.0	......	11, 16, 17	94	8, 10	52	67.3	......
Cathlamet	4	103	24	50	63.7	......	5	99	25	48	66.1	......
OREGON.												
Portland	4	102	14	55	73.3	0.20	6, 8	97	22, 23	57	72.2	0.20
Eola	5, 6	93	15	46	70.8	0.00	5, 6	92	24	49	69.0	0.08
Astoria	5	91	14, 17, 29, 31	55	63.5	0.74	7	91	23	55	63.6	1.95
Averages	....	......	....	......	69.2	0.47	....	......	....	......	68.3	0.74

State and station.	SEPTEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	OCTOBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
MAINE.												
Houlton	19	84	28, 29	43	60.6	4.00	3	80	27	17	47.0	6.60
Orono	2	78	21, 28	39	57.8	2.23	2, 10, 11	69	27	21	47.3	5.53
Surry	1, 4	82	21	40	61.0	......	2	73	27	23	50.7	......
Williamsburg	....	......	....	......	......	......	2	68	27	20	45.9	6.90
West Waterville	1	85	29	43	62.2	1.37	25	78	27	27	50.3	5.36
Gardiner	1, 4	79	13	45	60.6	1.33	2	69	27	26	49.8	6.39
Lisbon	15	84	13	36	60.5	1.27	2	76	27	20	49.4	5.55
Norway	15	85	21, 27	40	60.6	1.23	2	74	27	22	48.5	3.25
Cornish	1, 22	82	12	44	61.4	1.31	2	72	27	22	49.1	4.35
Cornishville	1	81	29, 30	49	63.4	0.90	17	73	27	24	50.9	7.20
Averages	....	......	....	......	60.9	1.71	....	......	....	......	48.9	5.68
NEW HAMPSHIRE.												
Stratford	2	86	12	35	57.9	1.45	2, 16	70	27	20	45.5	4.47
Whitefield	2	82	8, 12, 29	37	57.6	0.50	16	72	27	16	46.2	3.70
Tamworth	1	85	27, 29	34	59.1	1.15	16, 25	71	27	10	47.4	5.59
Contoocookville	1	88	11, 12	46	62.8	......	16	75	27	19	49.8	......
Goffstown Center	1, 2	90	7, 11, 12, 30	48	64.2	1.71	10	79	27	24	52.5	3.89
Averages	....	......	....	......	60.3	1.20	....	......	....	......	48.3	4.41
VERMONT.												
Lunenburg	4	80	12	38	60.4	3.00	12	79	27	17	46.7	3.00
North Craftsbury	2	83	12	30	55.0	2.28	12	67	19	27	44.4	5.67
Newport	2	85	12	36	58.9	2.66	2, 16	70	27	22	47.2	5.50
East Bethel	1, 2	85	12, 13	35	60.3	2.12	12, 16	71	27	20	48.7	4.68
Woodstock	1, 2	84	13	37	57.0	4.93	2, 16	68	27	18	45.4	3.80
Near St. Albans	2	79	28	40	59.1	3.10	16	70	27	24	48.0	5.50
West Charlotte	1	88	12	42	64.7	3.63	12	74	27	28	52.1	5.84
Panton	2	84	6, 29	46	62.9	3.76	2	69	27	25	49.1	5.25
Castleton	1, 2	83	12	38	60.4	2.01	16	72	27	25	49.7	3.35
Averages	....	......	....	......	59.9	3.05	....	......	....	......	47.9	4.73
MASSACHUSETTS.												
Kingston	1	87	12	44	63.0	1.25	1	74	30	30	54.3	8.25
Topsfield	1, 4	81	13	40	60.9	0.65	....	......	....	......	......	......

Meteorology of 1870—Continued.

State and station.	SEPTEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	OCTOBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MASS.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Lawrence	......	......	......	......	......	......	1	71	27	26	52.4	4.35
Georgetown	......	......	......	......	......	......	17	71	24, 27	30	51.6	5.37
Milton	4	89	12, 13	42	63.6	1.28	16	79	30	30	54.6	3.94
Cambridge	1	84	19, 28	51	65.3	......	1	76	27	29	55.3	......
North Billerica	1	88	12, 13	40	63.9	......	16	74	24	25	52.8	......
West Newton	1	93	12	42	66.3	1.79	1	82	30	29	56.0	6.46
New Bedford	......	......	......	......	......	......	1	78	27	29	54.0	6.42
Worcester	1	81	13	43	61.0	1.40	1	72	27	28	52.1	5.89
Mendon	1	83	13, 20	44	62.5	1.60	1	72	30	26	52.5	3.90
Lunenburg	1	86	12	47	63.8	2.41	1	74	27	26	52.8	6.95
Amherst	1	84	12	40	62.3	1.75	2	72	27	26	52.1	4.49
Richmond	......	......	......	......	......	......	15, 16	70	27	26	52.4	6.55
Williams College	1	81	12	39	60.6	2.21	2, 16, 25	70	27	21	49.6	4.30
Hinsdale	......	......	12	46	60.9	......	......	......	......	......	......	......
Averages	......	......	......	......	62.8	1.60	......	......	......	......	53.0	5.57
RHODE ISLAND.												
Newport	16	81	13	51	66.8	1.57	1	79	27	29	56.6	5.88
CONNECTICUT.												
Columbia	23	90	13	42	66.2	1.05	1	80	27	28	55.1	4.15
Middletown	1	89	12	41	64.5	0.96	2, 5	76	27	25	53.8	4.10
Southington	1	84	11, 12	50	64.5	1.16	1	73	27	30	53.4	4.32
Colebrook	1	87	12	43	62.3	1.55	16	72	27	24	50.5	6.94
Brookfield	2	90	12, 13	42	64.6	4.50	4	70	27	32	55.6	8.20
Averages	......	......	......	......	64.4	1.84	......	......	......	......	53.7	5.54
NEW YORK.												
Moriches	1	80	12, 22	44	60.3	2.65	1	75	30	30	51.5	3.76
South Hartford	1	88	20	47	66.8	2.15	16	76	27	25	53.8	2.95
Caldwell	23	82	12	44	63.0	5.35	2, 16	72	27	19	49.9	8.45
Garrison's	3	85	12, 13, 19	49	63.8	2.55	4	71	27	28	52.3	5.33
Throg's Neck	24	83	11, 12, 13, 14	55	68.2	......	1	80	27	37	58.5	......
White Plains	3	80	12	48	63.9	......	1	74	30	31	56.0	......
Cooper Union	25	84	12	55	68.9	2.38	1	77	30	36	58.4	5.72
Flatbush	25	86	12	51	65.9	1.29	......	......	......	......	......	......
Brooklyn	24, 25	84	12	51	67.7	1.70	1	82	27	37	58.5	5.50
Glasco	3	84	12	40	63.6	2.34	1, 2	75	......	......	......	......
Newburg	3, 4, 21	84	13, 19, 20	56	68.2	1.65	1, 3	75	27	34	57.6	5.01
Minaville	1	85	12	42	65.6	2.40	2, 16	72	30	27	52.8	1.95
Cooperstown	2	85	12	35	61.0	2.76	16, 17	72	30	23	49.9	3.80
Gouverneur	2	81	12	37	58.7	4.10	2	71	30	22	48.3	3.64
North Hammond	1	93	10, 11	54	68.8	3.13	2	78	27	32	54.9	6.72
Houseville	1	83	11	42	61.1	4.08	2, 16	72	26, 30	26	49.2	4.99
Utica	1	85	12	42	62.8	3.10	16	74	30	28	52.1	4.36
South Trenton	15	82	13	40	61.6	1.18	17	78	30	24	51.9	8.00
Cazenovia	1	85	12	39	61.1	......	16	71	30	27	49.7	......
Oneida	1	86	12	42	60.5	7.20	17	74	......	......	54.5	4.96
Depauville	1	82	28	46	62.7	4.57	2	75	19, 30	28	50.1	3.98
Oswego	2	79	13	43	61.4	2.28	16	69	30	32	51.6	4.98
Palermo	2	86	12	40	61.9	3.75	2	72	30	27	49.9	2.20
North Volney	1	87	13	43	63.6	......	16	77	30	29	53.8	......
Waterburg	2	87	11, 13	37	60.2	......	12	72	30	21	48.3	......
Nichols	2	87	20	38	62.3	......	16	75	30	23	50.4	......
Newark Valley	1	88	13	34	61.4	2.20	16	74	30	24	50.4	3.80
Himrods	1	84	20	43	62.9	3.19	16	71	30	28	44.7	1.06
Rochester	9	84	20	47	64.2	5.01	......	......	......	......	......	......
Little Genesee	1	85	22	37	60.4	3.51	16	74	30	25	49.2	2.13
Suspens'n Bridge	8	86	20	46	64.1	3.85	16	74	30	36	52.2	3.25
Lockport	1	82	20	50	63.8	3.75	21	78	19, 30	34	52.1	2.39
Buffalo	8	91	12, 19	46	64.7	3.92	16	75	19	31	52.4	4.55
Averages	......	......	......	......	63.5	3.19	......	......	......	......	52.2	4.31

Meteorology of 1870—Continued.

State and station.	September. Date.	September. Maximum temperature.	September. Date.	September. Minimum temperature.	September. Mean temperature.	September. Rain and melted snow.	October. Date.	October. Maximum temperature.	October. Date.	October. Minimum temperature.	October. Mean temperature.	October. Rain and melted snow.
NEW JERSEY.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Paterson	3	90	12	47	66.3	2.77	1	77	27, 30	32	54.9	4.84
Newark	25	83	13	47	65.3	2.80	1	76	27	32	55.4	4.75
South Orange	25	86	20, 22	44	65.3	3.07	1	78	27	30	55.2	5.64
Trenton	1, 24, 25	84	12	50	70.3	1.34	1	80	27	37	59.8	5.23
Rio Grande	1	90	20	45	68.6	2.88	4	79	23	40	57.8	3.13
Moorestown	2	86	12, 13	52	66.8	1.28	1	76	30	34	56.0	4.82
New Germantown	25	87	13	46	65.8	2.08	1	77	27	33	54.8	4.86
Readington	14	84	13	42	64.8	......	15	76	30	30	55.6	......
Haddonfield	1, 2, 25	82	12, 15	51	65.7	1.92	1	77	30	35	55.5	3.78
Greenwich	3, 25	79	12, 13, 20, 21	52	66.5	2.33	1	78	19	38	57.4	1.92
Vineland	1	85	12	49	67.3	2.83	1	81	19, 30	36	57.3	1.05
Averages	......	......	......	......	66.6	2.33	......	......	......	......	56.3	4.00
PENNSYLVANIA.												
Nyces	1	83	11, 30	40	60.0	1.20	9, 16	73	30	25	49.3	2.40
Hamlinton	1, 2, 15	84	11, 21	47	63.0	1.47	16	75	27	29	51.4	3.60
Dyberry	15	81	20	31	60.4	1.31	......	......	......	......	......	......
Fallsington	25	86	13	48	71.0	1.50	1	79	27, 30	37	57.0	4.50
Philadelphia	3	85	12	54	70.1	1.60	1	79	27	39	59.3	4.11
Germantown, (M)	26	89	12	52	68.7	......	12	79	19	38	55.7	......
Do (T)	24	86	12, 20	53	68.7	1.97	1	78	30	36	55.4	3.25
Horsham	25	86	12, 20	50	66.4	2.92	1	76	30	36	55.4	6.41
Plymouth Meet'g	25	86	12, 20	47	66.2	2.19	1	77	30	35	55.8	6.02
White Hall	25	87	12	38	67.1	......	1	78	30	29	54.6	......
Factoryville	1	84	12, 20	36	61.1	2.45	12	74	30	22	50.2	4.09
Reading	25	84	12	48	67.6	2.38	1	77	30	37	57.2	3.00
West Chester	25	86	20	49	66.5	3.24	1	78	19, 30	37	55.5	4.48
Parkersville	2	84	12, 13	50	67.8	2.12	1	77	24	41	56.6	4.78
Tamaqua	24	88	20	33	61.5	2.30	1	76	23, 29	24	54.5	1.90
Catawissa	25	87	12	38	62.5	......	9, 16	75	23	32	54.4	......
Ephrata	24	86	13, 14, 15, 20	50	67.2	4.48	1	78	27, 30	36	54.5	2.82
Mount Joy	......	......	......	......	......	......	17	78	19	37	57.4	......
Carlisle	1, 25	86	12, 13	47	66.3	6.00	1, 16	72	19, 23	38	......	......
Fountain Dale	25	84	12	51	65.7	5.58	1, 25	73	21	40	56.2	2.02
Tioga	2, 3	86	12	36	63.3	4.40	2	72	19, 30	24	51.0	3.20
Lewisburg	24	81	13	42	63.1	2.57	25	73	23	32	52.0	3.38
Grampian Hills	8	84	20	36	60.4	2.78	21	71	19	26	47.5	......
Johnstown	8	80	20	43	63.0	2.82	17	76	19	33	53.3	4.21
Franklin	8	91	20, 21, 22	45	64.1	2.02	16, 24	74	19	31	51.7	4.91
Pittsburg	8, 9	84	21	48	66.9	1.10	16, 27	74	23, 31	37	55.9	3.29
Greencastle	25	89	20	47	69.2	6.60	......	......	......	......	......	......
Connellsville	9	88	20	48	67.4	......	10	78	19	32	55.3	......
Brownsville	9	90	22	48	71.0	......	15, 17, 27	75	14, 22, 24	40	58.6	......
Newcastle	8, 9	80	22	45	66.2	1.90	16, 17, 25	69	19	27	54.1	2.40
Beaver	7	82	20, 21	46	65.3	......	27	72	19, 23	35	53.2	2.20
Canonsburg	8	89	21	41	65.6	2.04	16, 21	81	19	30	54.0	3.06
Averages	......	......	......	......	65.6	2.73	......	......	......	......	54.4	3.63
DELAWARE.												
Milford	1	86	20	52	66.9	4.10	1	79	19	30	56.0	2.70
Dover	25	86	13, 14	55	68.3	3.80	1	81	19, 31	41	58.7	1.10
Averages	......	......	......	......	67.6	3.95	......	......	......	......	57.4	1.90
MARYLAND.												
Woodlawn	2, 24, 25	82	12	49	66.6	3.56	1	78	19, 30	36	56.7	4.56
Fallston	14	93	12	54	68.2	4.20	1	82	19	43	56.3	4.20
Annapolis	2, 25	83	23	55	71.2	1.96	1	80	21	41	60.6	3.50
Mt. St. Mary's	25	83	12	52	65.6	6.61	1	75	19	39	55.2	1.30
Averages	......	......	......	......	67.9	4.03	......	......	......	......	57.2	3.39

Meteorology of 1870—Continued.

State and station.	SEPTEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	OCTOBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
		Deg.		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
DIST. OF COLUMBIA.												
Washington	2	83	14	51	68.8	1.78	1	79	19	44	59.5	3.90
VIRGINIA.												
Johnsontown.....	4	85	12	56	71.0	1.05	1	80	21	42	61.9	2.55
Hampton	3, 25	86	10	56	71.7	3.70	1	82	10, 14, 16, 19	45	62.3	2.25
Surry C. H.......	3,4,25,26	91	12	53	73.1	1.68	1	90	15	39	63.2	2.75
Comorn	2	86	21	54	71.3	1.25	1	82	21	47	62.7	3.09
Vienna............	7	78	11	58	69.7	2.20	10	71	19	43	57.0	5.00
Piedmont	24	88	13	52	67.2	10.40	9	79	21	38	57.5	2.00
Piedmont Station	25	86	20, 23	50	66.9	9.55	25	78	19	34	56.0	2.10
Staunton..........	2, 7	78	20	47	64.3	11.24	28	73	21	39	55.0	2.13
Lexington	1	85	13	50	66.8	15.88	28	78	21, 22	34	54.8	2.87
Lynchburg	26	82	20, 21	53	69.8	9.25	28	76	21	44	60.5	3.50
Near Wytheville.	7	80	20, 21	45	64.2	1.30	27	71	9, 22, 23	34	54.3	2.80
Averages....	......	......	......	......	68.7	6.14	......	......	......	......	58.7	2.82
WEST VIRGINIA.												
Romney	2, 25	90	20	48	69.9	......	......	......	......	......	......	......
Weston	8	86	20, 21	38	64.9	......	27	75	19, 23	30	53.0	......
NORTH CAROLINA.												
Goldsboro.........	26	96	10, 12	64	76.3	2.85	2	90	22	40	68.0	4.00
Warrenton........	26	79	13, 20, 23	60	69.3	1.60	1	76	21	48	62.7	2.10
Oxford............	25, 26	84	12, 20	55	69.8	1.35	3, 26, 28	78	23	43	60.9	1.20
Raleigh	4	83	7, 20	54	68.5	......	......	......	......	......	......	......
Albemarle	2	92	8	52	70.4	1.14	28	85	14, 17, 22, 31	38	60.9	2.80
Statesville	26	82	24	50	......	4.25	26, 27, 29	74	21	32	55.3	3.13
Asheville, (A)....	27	77	21	48	64.4	2.50	27	74	21	33	55.3	2.00
Do....(H).....	1, 3	74	22	48	63.4	......	29	70	21	32	55.1	......
Averages....	......	......	......	......	68.9	2.28	......	......	......	......	59.7	2.54
SOUTH CAROLINA.												
Bluffton	3, 18, 26	90	21, 22	70	77.8	5.20	12	86	21, 22	56	71.6	8.40
Gowdeysville	25, 26	86	21, 25	63	73.1	2.05	......	......	......	......	......	......
Aiken	25	87	22	63	......	0.83	28, 29	80	21	49	65.3	4.40
Averages....	......	......	......	......	75.4	4.04	......	......	......	......	68.4	6.40
GEORGIA.												
Berne.............	4	91	20	61	72.4	5.00	3	79	21	47	66.1	5.05
St. Mary's	4	92	19	69	77.0	......	3, 31	81	21	50	70.2	......
Penfield	26	87	20, 22, 24	62	71.9	2.25	29	82	21	42	61.7	2.77
Atlanta...........	......	......	......	......	......	......	23	76	13	46	61.5	0.19
Averages....	......	......	......	......	73.8	3.62	......	......	......	......	65.6	2.64
ALABAMA.												
Rockville	6	86	13	62	76.5	3.43	27, 28, 29, 30	78	21	40	64.2	1.33
Carlowville	5	90	13	64	75.2	2.97	19	84	21	47	66.9	0.57
Greene Springs ..	3, 5, 6	87	24	59	74.0	0.40	19	82	21	41	64.8	0.30
Coatopa...........	6, 26	90	30	60	74.6	2.70	19	86	21	39	65.0	1.80
Fish River	......	......	......	......	......	......	3	80	......	......	......	0.33
Averages....	......	......	......	......	75.1	2.37	......	......	......	......	65.2	0.88

Meteorology of 1870—Continued.

State and station.	September. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	October. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
FLORIDA.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Near Port Orange	3	86	23	68	77.6	11.88	1, 2	84	21	55	74.2	13.16
Saint Augustine	1, 3	90	21, 22	70	78.4	7.00	5	88	21	54	75.6	......
Jacksonville	1, 2	93	22	71	77.2	9.35	3	87	21	52	73.0	7.10
Pilatka	3	96	19	68	79.4	11.04	5, 12	90	21	52	74.7	4.32
Ocala	5, 19	96	20	68	81.0	......	......	......	......	......	......	......
Orange Grove	2,3,4,5, 6	90	24, 27	74	80.7	6.57	11	88	21	57	75.8	9.75
Newport	5	89	19, 21, 22	68	76.0	7.02	11	81	14, 22	48	68.0	2.45
Chattahoochee	10	90	20	69	79.0	2.91	......	......	......	......	......	......
Averages	......	......	......	......	78.7	7.97	......	......	......	......	73.5	7.36
TEXAS.												
Clarksville	7, 19	87	30	65	79.0	......	27, 29	79	20	50	69.7	......
Gilmer	22	98	30	62	78.8	1.62	2, 4	87	20	43	68.2	3.71
Palestine	......	......	......	......	......	......	3	89	20	48	71.5	6.70
Oakland	4	98	29	68	81.4	0.65	3,5,11,27	88	19	54	72.4	7.64
Blue Branch, (W)	4	94	28	61	77.4	0.70	4	84	20	44	68.7	10.00
Do ......(G)	17	94	1	67	79.2	1.00	......	......	......	......	......	......
Bluff	3, 4, 5	94	28	66	81.0	0.63	15	88	20	48	72.1	6.50
Clinton	3, 4	95	1, 2, 24	68	79.1	1.45	2, 4	88	20	47	70.8	4.40
Austin	4	94	28	65	78.3	1.67	5, 27	86	20	47	68.2	12.63
San Antonio	3, 4	100	30	63	80.8	3.90	5	90	20	43	70.8	5.60
Averages	......	......	......	......	79.4	1.45	......	......	......	......	70.3	7.14
LOUISIANA.												
New Orleans	7, 25	88	30	64	77.0	1.30	16	81	21, 22	49	65.9	0.30
Near Cheneyville	7, 11, 14	90	29	63	79.7	......	......	......	......	......	......	......
Shreveport	5, 7, 8	89	28, 30	66	78.1	......	5	85	14, 20	44	66.1	......
MISSISSIPPI.												
Columbus	4	87	21, 30	64	74.4	2.04	27, 28	81	21	40	64.4	1.01
Enterprise	19	96	8, 11, 12, 20, 28, 30	63	75.6	3.20	......	......	......	......	......	......
Philadelphia	6, 7	88	24, 25, 29, 30	64	74.7	2.40	28, 29	78	20, 21	45	64.5	2.10
Grenada	26	92	24	58	73.5	4.25	3, 18, 23	80	13, 21	38	62.9	0.95
Near Brookhaven	5, 6	90	24	61	72.8	3.90	23	89	20	36	65.3	1.40
Holly Springs	6	94	25	67	71.0	2.90	3	78	23	39	64.0	0.10
Averages	......	......	......	......	73.7	3.11	......	......	......	......	64.2	1.41
ARKANSAS.												
Helena	6, 7	96	28	59	76.6	......	29	87	21, 31	42	63.7	......
Mineral Springs	5, 6, 7	88	30	58	74.1	4.19	23	86	21	40	62.2	2.13
Fayetteville	......	......	......	......	......	......	27, 28	82	20	37	61.8	3.74
TENNESSEE.												
Elizabethton	1	88	20, 21, 22	52	69.2	2.10	27	78	21	32	57.8	3.17
Lookout Mount'n	10	81	21	61	70.3	......	29	81	20	42	61.9	......
McMinnville	6, 8, 26	81	19, 24	60	64.3	......	27	79	21	37	59.1	1.89
Austin	8	85	4, 30	60	70.5	3.52	1,3,6,7,28	80	14	36	60.6	3.64
Clarksville	6, 7	82	19	58	69.9	3.35	27	82	22	42	60.2	2.15
Trenton	7	94	29	57	73.3	1.70	27	90	13, 21	41	63.5	2.90
La Grange	7	92	19	62	74.4	1.90	26, 27, 28	84	20, 21	44	64.4	0.70
Averages	......	......	......	......	70.3	2.51	......	......	......	......	61.1	2.41

Meteorology of 1870—Continued.

State and station.	SEPTEMBER.						OCTOBER.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
KENTUCKY.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Pine Grove	8	86	20	58	69.7	3.61	27	76	21, 22, 31	38	56.8	2.24
Danville	8	90	6, 20, 21	62	72.8	3.50	1, 16	79	....	......	62.9	1.48
Shelby City	7	85	20	56	70.4	3.35	1	76	14, 21	41	58.0	2.48
Near Louisville	7	92	5, 20, 21	51	72.0	2.38	27	81	22	37	59.8	3.89
Averages	......	......	....	......	71.2	3.21	....	......	....	......	59.4	2.52
OHIO.												
Salem	2	87	20	48	65.8	2.75	27	76	19, 31	33	52.5	2.35
Steubenville	8	84	20, 21	49	68.8	2.73	16, 17, 27	70	19	36	55.7	1.90
Painesville	8	82	12	50	65.4	4.56	27	72	19, 21, 31	40	53.9	9.13
Milnersville	8, 9	87	19	48	66.8	3.00	1	68	10, 19, 22	30	......	3.80
Cleveland	1, 8	82	20	50	64.7	4.76	16, 27	73	18, 22	37	53.8	5.36
Wooster	8	96	22	46	69.7	......	16, 24	80	19	30	54.6	......
Pennsville	8	90	12	48	66.9	0.65	27, 28	74	22	37	58.8	1.20
Gallipolis	8	88	21	48	70.3	1.43	27	76	21	36	58.0	......
Adams' Mills	8	89	22	46	67.7	1.73	27	77	14	32	55.3	2.37
Oberlin	1, 7, 8	88	13	46	65.6	2.55	16	76	18, 31	32	53.1	3.35
Kelley's Island	1	86	11, 12, 20	62	70.5	1.50	16	73	18	41	57.8	3.13
Sandusky	1	87	20	51	64.7	1.83	16	75	19	39	55.7	4.64
Carson	1	89	12	50	68.3	2.40	16	72	31	38	55.6	2.90
North Fairfield	8	90	5, 11, 12	55	69.0	1.42	24	76	18, 31	38	55.6	3.45
Gambier	16, 24	80	21, 22	46	64.8	2.74	27	70	23	34	52.7	2.70
Westerville	8, 9	91	20	51	68.5	1.37	27	76	31	33	54.8	2.77
Williamsport	....	......	....	......	......	......	10, 28	84	23	30	57.7	3.95
North Bass Island	1	92	3, 4	61	70.4	1.53	16	76	31	41	57.3	3.50
Marion	8	88	12, 20	49	66.3	1.10	16	74	29	36	53.0	2.84
Hillsboro	8	84	12	53	67.8	0.69	27	74	31	39	55.2	2.32
Bowling Green	8	95	19	46	69.7	2.85	16	82	29, 31	36	56.5	4.85
Kenton	9	95	29	58	71.9	7.65	3	70	30, 31	37	51.8	4.70
Bellefontaine	8	90	3	52	68.0	1.50	16	74	31	33	53.7	3.86
Urbana	8	92	5, 21	54	69.0	0.47	27	75	29, 31	34	54.9	4.00
Springfield	8	92	21	53	......	0.50	....	......	....	......	......	......
Bethel	7, 8	90	5	55	68.5	1.50	27	78	31	37	54.4	1.38
Carthagena	7, 8	88	12	54	70.8	1.80	....	......	....	......	......	......
Jacksonburg	7, 8	90	18	56	71.4	1.39	17	76	31	38	57.7	3.30
Mt. Auburn Inst.	8	87	12	57	72.0	0.49	16	76	31	39	58.8	2.67
Cincinnati, (H)	8	95	12	57	72.0	0.30	16	77	31	38	58.1	2.77
Do... (P)	7	88	21	59	72.6	0.70	1	78	31	39	59.0	3.23
College Hill	8	96	19, 20	59	72.6	0.15	1, 2	84	19, 20, 31	42	60.1	3.69
Averages	......	......	....	......	68.7	1.93	....	......	....	......	55.7	3.44
MICHIGAN.												
Detroit	8	92	4, 13, 20, 21	53	67.3	1.71	27	78	31	31	53.8	4.78
Monroe City	1, 8	88	4, 11, 12, 20	58	71.2	2.26	16	82	31	38	59.1	3.73
Ann Arbor	8	89	5, 12	51	61.8	2.42	16, 24, 27	72	18	34	52.2	3.53
Alpena	8	74	3, 11, 16, 17	52	61.9	2.97	1, 2	70	31	35	51.8	4.20
State Agr'l Coll	8	90	12, 19	41	63.7	2.85	....	......	....	......	......	......
Litchfield	7	87	12	49	64.9	4.20	24	72	29	32	51.8	5.98
Cold Water	8	89	12	44	65.4	1.81	3	76	....	......	52.7	4.75
Gr'd Rapids, (H)	7	89	12	49	67.6	2.77	7	80	29	33	53.0	5.07
Do......(S)	....	......	19	47	63.0	3.10	24	73	29	31	52.6	4.84
Northport	7	82	2, 3	50	62.7	2.75	1	71	31	35	51.4	8.00
Otsego	6, 7	100	20	41	67.6	......	....	......	....	......	......	......
Copper Falls	7	76	2	44	57.4	1.05	2	73	26	29	42.7	2.80
Ontonagon	21	78	26, 27, 28	50	61.7	......	2	70	25, 26, 29	34	48.9	......
Averages	......	......	....	......	64.6	2.54	....	......	....	......	51.8	4.77
INDIANA.												
Aurora	7	95	5, 20, 21	56	72.5	0.42	25	80	31	36	57.3	3.57
Vevay	8	90	20	53	71.4	1.20	27	80	22	39	58.1	2.43

Meteorology of 1870—Continued.

State and station.	SEPTEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	OCTOBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
INDIANA—Cont'd.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Mount Carmel	7	91	12, 19	58	70.8	2.20	9	74	31	38	57.7	1.50
Spiceland	8	94	12	54	69.1	2.05	16, 25	76	31	33	55.6	4.06
Laconia	8	87	21	57	70.1	2.33	27	82	31	39	58.3	2.86
Columbia City	......	......	......	......	......	......	17	78	29	37	56.1	2.25
Knightstown	8	91	21	50	69.7	1.37	3, 16, 17, 24, 25	74	31	31	56.4	4.62
Warsaw	......	......	......	......	......	......	27	73	22	35	59.3	4.20
Indianapolis	8	88	21	51	68.0	1.09	27	74	31	33	55.8	2.93
Near La Porte	8	91	4	54	68.1	2.75	24	76	31	36	55.0	2.60
Rensselaer	23	87	12	50	69.3	2.10	9	75	31	30	52.6	4.50
Annapolis	......	......	......	......	......	......	27	79	31	28	55.5	3.10
Merom	7	99	4, 19, 25, 26	60	70.7	0.58	16, 27	78	31	33	59.3	2.50
New Harmony	7, 8	86	30	57	70.5	2.00	26	77	22	38	58.8	2.69
Harveysburg	7	84	28	54	67.0	4.30	......	......	......	......	......	......
Averages	......	......	......	......	69.8	1.87	......	......	......	......	56.8	3.13
ILLINOIS.												
Chicago	7, 8	90	4	57	70.3	2.82	3, 24	77	31	34	56.8	2.43
Near Chicago	8	90	2, 22	58	65.8	......	24	80	31	29	54.9	......
Evanston	8, 29	86	4	57	67.0	3.34	23	72	31	32	53.8	4.39
Marengo	7	87	4	47	64.7	5.36	1	73	31	26	50.2	3.14
Charleston	7, 8	88	5	52	68.2	0.66	15, 16, 27	77	31	30	54.9	3.46
Mattoon	7, 8	86	19	52	69.7	1.44	27	75	31	35	56.7	3.50
Aurora	7, 8	86	18, 19	54	66.3	3.63	15, 23, 24	72	31	28	51.0	4.63
Louisville	7, 8	92	3, 4, 5, 12, 19, 20, 21, 23, 24, 30	60	69.2	1.30	15	82	31	34	59.0	3.50
Golconda	10	95	22	50	72.8	1.60	......	......	......	......	......	......
Belvidere	7	91	18, 19	52	65.7	4.06	24	76	31	27	51.3	3.37
Ottawa	8	93	18	55	69.1	3.63	15	78	31	34	55.0	4.29
Decatur	7	89	5	54	68.7	2.60	27	78	31	34	56.3	3.30
Pana	7	86	19, 25	56	68.9	3.55	27	76	31	30	54.7	2.40
Winnebago	7	86	12	51	65.2	3.92	1, 24	72	31	26	50.4	2.75
Rochelle	......	......	......	......	......	......	2, 15	74	31	26	50.6	......
Wyanet	7	89	19	47	67.2	6.69	24	78	31	28	53.6	3.62
Hennepin, (S)	......	......	......	......	......	......	15	76	31	29	52.0	......
Do. ..(O)	7	89	12, 19	54	68.3	3.10	24	77	31	30	53.3	4.20
Peoria	7	91	10	56	70.3	3.56	15	79	31	31	55.4	4.27
Havana	7	90	19	53	67.0	3.36	15	80	31	30	53.1	3.95
Waterloo	......	......	......	......	......	......	27	78	31	33	54.5	......
Dubois	7	92	29	58	72.3	2.32	27	81	21	37	59.5	2.38
Galesburg	7	84	19	56	66.7	3.96	15, 24	75	31	31	55.2	4.46
Manchester	21, 22	90	4	56	69.8	2.61	12	80	31	30	57.0	2.43
Mount Sterling	8	83	4, 19	58	69.1	4.37	14, 15	78	31	32	56.8	3.15
Andalusia	7	84	19	50	68.1	......	15, 23, 24	74	22, 31	31	53.6	......
Oquawka	7	90	3	52	68.6	6.55	15	81	31	35	56.1	4.12
Augusta	7	85	19, 25	54	67.8	5.78	15	78	31	30	54.5	5.20
Warsaw	6, 7	90	19	55	67.9	4.12	15	84	31	35	55.6	5.08
Averages	......	......	......	......	68.3	3.51	......	......	......	......	54.5	3.65
WISCONSIN.												
Sturgeon Bay	7	86	2, 3, 11, 17, 18, 26	51	64.0	3.05	2	72	26	32	51.0	4.30
Manitowoc	8	81	20	50	63.3	1.13	1, 24	70	31	32	51.6	1.80
Hingham	......	......	......	......	......	......	1	75	31	27	51.2	......
Milwaukee	7	87	5	47	64.1	2.10	24	73	31	30	51.9	1.99
Geneva	7	92	5	51	65.1	3.11	2, 24	75	31	27	49.6	4.05
Waupaca	7	88	12, 13, 19, 20	50	63.4	......	......	......	......	......	......	......

Meteorology of 1870—Continued.

State and station.	SEPTEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	OCTOBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
WIS.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Embarrass	7	81	12	46	61.8	3.35	2, 23	74	21	30	48.1	1.59
Rocky Run	7	84	12	50	64.7	2.50	2	73	31	28	50.8	0.88
Madison	7	83	5	54	61.2	4.00	1	70	31	29	50.6	2.01
Edgerton	7	83	4, 19	50	67.7	7.10	1	84	31	27	53.0	1.30
Mosinee	11	79	4	43	60.1	10.20	1, 8	75	31	22	44.9	3.85
Baraboo	7	88	20	49	64.2	1.69	2	73	31	28	50.6	2.75
Tunnel City	29	92	11, 28	48	64.3	2.20	1, 2	80	31	26	49.6	0.70
Bayfield	9	78	1	48	61.9	......	2	74	18, 31	28	47.4	......
Averages	....	......	....	......	63.5	3.68	....	......	....	......	50.1	2.30
MINNESOTA.												
Beaver Bay	19	79	28	42	59.4	1.82	13	80	31	26	47.3	0.95
St. Paul	21	81	6	53	64.8	3.28	2	81	31	21	48.2	1.95
Minneapolis	21	82	2, 23, 25, 26, 30	50	63.5	4.07	1	80	31	20	47.0	2.05
Sibley	15, 21	80	2	43	64.1	1.55	2	79	31	16	46.2	0.50
Koniska	10, 12, 19, 21, 29	76	20	46	60.2	2.50	2	76	31	20	45.3	1.10
Litchfield	10	82	26, 29, 30	50	63.8	5.00	1, 2	78	25, 31	26	46.2	1.10
New Ulm	15	81	25	46	65.8	2.01	2	82	31	26	49.0	0.73
Madelia	15, 27	85	24, 25	50	67.0	4.15	2	86	31	24	48.6	0.75
Averages	....	......	....	......	63.6	3.05	....	......	....	......	47.2	1.14
IOWA.												
Clinton	7	85	4	56	67.9	2.65	24	79	30, 31	28	51.8	2.50
Dubuque	7	88	19	51	65.9	3.98	1	72	31	26	50.7	1.22
Monticello	7	90	18	50	67.7	3.95	1	82	18, 31	26	51.8	1.55
Muscatine	....	......	....	......	......	......	24	75	31	28	52.1	3.95
Bowen's Prairie	6, 7	82	11	54	65.2	2.33	1, 2	76	31	22	50.9	1.35
Fort Madison	8	87	19	51	67.4	4.52	15, 24	73	18	32	54.2	4.68
Guttenberg	7	87	19	49	64.6	......	1	78	18, 22	25	49.3	......
Mount Vernon	7	83	11	52	64.9	......	1	76	31	24	50.1	......
Iowa City	7	90	4, 5, 9, 18	56	67.8	6.67	23	75	31	25	51.8	3.16
Independence	7	88	19	54	65.9	5.65	1	77	31	24	49.7	......
Near Independ'e	7	86	12, 19	57	66.1	5.26	1, 2, 23	76	31	26	50.0	1.00
Rockford	7	82	4	52	63.7	......	1	75	31	26	50.8	......
Iowa Falls	7	84	1, 2	56	69.2	9.33	1	76	13	38	57.1	4.04
Algona	6, 15	84	2	50	63.0	......	2	75	31	24	47.3	......
Webster City	10	90	28	47	64.0	8.04	2	78	31	22	48.1	2.06
Boonesboro	6	84	2	47	63.6	12.08	2	76	31	28	48.4	2.94
Fontanelle	5	87	2	51	65.4	11.75	2	79	31	27	51.1	4.63
Grant City	6, 7	86	2	48	65.3	7.11	2	80	31	30	50.0	0.65
Sac City	20	84	24	52	63.5	4.60	1, 2	77	28, 31	32	48.3	......
Logan	6	84	2, 4	48	62.2	9.90	1, 2	74	18	25	51.4	1.10
Woodbine	....	......	....	......	......	7.00	1	82	31	20	50.0	2.03
West Union	30	87	13, 19	51	66.9	5.16	1	88	31	24	51.4	1.95
Averages	....	......	....	......	65.5	6.47	....	......	....	......	50.7	2.43
MISSOURI.												
St. Louis	6, 7	89	25, 30	58	71.8	1.08	27	79	31	37	59.2	3.34
Allenton	7	97	25	52	68.8	0.99	15	85	31	29	56.8	4.13
Hematite	7	94	25	52	71.2	1.37	24	85	31	29	57.4	4.45
Hannibal	6, 7	88	25	54	68.6	7.30	15	80	18, 31	34	55.5	4.90
Rolla	6	91	25	53	70.3	2.33	15	81	31	30	56.9	3.56
Jefferson City	7	94	25	52	......	......	15	82	31	33	60.0	......
Kansas City	6	84	4	55	68.2	3.25	24	78	31	30	55.6	6.85
Harrisonville	6	88	27, 28	54	68.2	4.11	....	......	....	......	......	......
Oregon	6	91	4	54	67.9	4.20	1	82	31	33	56.1	6.14
Corning	7	88	24, 30	54	68.1	4.73	23	82	31	30	54.7	5.65
Averages	....	......	....	......	69.2	3.26	....	......	....	......	56.9	4.83

Meteorology of 1870—Continued.

State and station.	September. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	October. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
KANSAS.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Atchison	6	88	4	56	68.3	4.20	2	79	31	28	56.2	9.20
Williamstown	6	90	4, 23	54	69.0	4.09	2	86	31	32	58.5	7.95
Leavenworth	7	88	24, 27	52	67.6	4.60	1, 2	80	31	36	56.8	9.85
Williamsburg	6, 7	86	25	55	67.7	......	3	82	12	32	55.8	......
Olathe	6	88	24	51	67.8	3.15	1	79	31	26	55.9	6.10
Paola	6	89	27	52	68.4	2.69	2, 4, 24, 26	78	31	26	57.1	5.67
Baxter Springs	6	92	24, 30	60	74.4	4.70	3, 14, 15, 26, 29	80	20	36	62.4	7.20
Lawrence	6	89	24, 25, 28	55	67.9	2.82	1	79	31	32	56.5	6.96
Holton	6, 7	91	25	51	67.8	5.00	2	81	22	22	55.8	7.25
State Agr'l Coll	6	92	24	52	68.3	4.57	23	78	31	20	56.6	5.06
Council Grove	6	90	23, 24	54	69.4	7.50	2	80	20, 31	28	60.5	8.45
Douglass	5, 6	90	23	52	68.3	4.03	5	82	31	32	57.2	6.45
Averages	......	......	......	......	68.7	4.30	......	......	......	......	57.4	7.29
NEBRASKA.												
Omaha Agency	6	91	4	50	67.3	4.46	9	78	18	32	54.1	0.77
De Soto	6	89	24	49	63.6	6.79	2	79	31	29	50.8	0.88
Bellevue	7	89	3, 4	53	66.3	6.60	2	79	31	30	53.7	2.32
Nebraska City	6	92	4	51	65.9	7.10	1, 2	79	31	28	53.4	2.55
Newcastle	20	87	24	43	62.7	11.50	13	69	18, 24	23	......	......
Averages	......	......	......	......	65.2	7.29	......	......	......	......	53.0	1.63
UTAH.												
Coalville	3	85	26	34	58.2	......	3	82	29, 30	23	46.0	......
CALIFORNIA.												
Monterey	21, 22	80	19	48	63.2	0.00	6	90	24	40	58.5	0.46
Chico	21, 22	96	23	54	72.7	......	7	99	18, 19	40	63.8	1.10
Watsonville	......	......	......	......	......	......	15	98	25	36	61.2	0.30
Cahto	1, 2	95	25	51	66.5	0.20	7	94	26	31	63.0	0.00
Visalia	1, 2	97	23	53	71.7	......	7	90	16, 19	40	61.1	0.86
Averages	......	......	......	......	68.5	0.20	......	......	......	......	61.5	0.54
MONTANA.												
Deer Lodge City	9, 11	84	7, 22	26	52.3	1.62	3	81	24	6	39.5	0.66
COLORADO.												
Denver	4	89	22, 24, 26	40	60.1	2.85	1	83	27	27	47.8	0.68
WASHINGTON.												
Port Angeles	2	68	21	50	57.4	4.50	5	63	18	42	51.7	3.50
Cathlamet	1	88	21	39	59.2	......	......	......	......	......	......	......
OREGON.												
Portland	2	91	20	49	63.4	0.45	2	77	27, 28	36	54.0	0.55
Eola	2	85	24	45	59.3	0.71	6, 8	72	25, 27	28	48.1	0.90
Astoria	22	76	20	51	58.7	3.04	5, 6	67	25	38	52.1	1.82
	November.						**December.**					
MAINE.												
Houlton	3	58	30	15	33.5	6.01	11	50	24	−10	23.9	5.10
Orono	3	57	30	21	36.6	5.61	2	43	24, 30	−5	24.4	3.01
Surry	3	59	17, 30	20	38.7	......	2, 13	46	25	−3	26.7	......
Williamsburg	3	47	22	16	31.2	5.75	2	40	25	−10	18.2	2.10
West Waterville	3	61	22	24	37.6	4.34	2	46	25, 30	0	26.8	2.60

Meteorology of 1870—Continued.

State and station.	NOVEMBER.						DECEMBER.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MAINE—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Gardiner	3	56	17	27	39.5	4.19	2	46	24	— 2	27.0	2.82
Lisbon	3, 27	58	17	18	38.7	3.40	2	50	24	— 9	25.8	2.25
Norway	3	59	17	19	35.9	3.40	2	46	24	— 4	23.7	1.85
Cornish	3	60	22	24	36.5	3.89	1	47	25, 30	— 1	25.8	2.20
Cornishville	3	61	22	24	37.9	4.60	2	47	25	0	26.3	3.00
Averages	......	......	......	......	36.6	4.58	......	......	......	......	24.9	2.77
NEW HAMPSHIRE.												
Stratford	2	58	16	12	34.6	5.42	2	44	30	—12	20.9	1.70
Whitefield	2	59	22	13	33.5	4.58	1	45	30	—19	31.9	1.13
Mt. Washington	25	27	30	0	16.5	......	13	29	24	—15	11.5	......
Tamworth	5	56	17	15	35.7	4.05	1	49	24, 30	—13	25.3	2.25
Contoocookville	2	63	17	19	41.3	......	1, 2	50	25	— 2	29.3	......
Goffstown Center	3	63	16, 17, 18	25	38.9	2.34	2, 5	48	25	— 2	24.6	1.69
Averages	......	......	......	......	33.4	4.10	......	......	......	......	23.9	1.69
VERMONT.												
Lunenburg	9	56	22	18	33.7	6.15	2	40	25	—18	21.8	0.80
North Craftsbury	2	62	22, 30	13	31.7	3.29	1	41	30	—18	18.8	2.28
South Troy	......	......	......	......	......	......	......	......	30	—16	18.1	......
Newport	9	55	30	18	35.5	4.81	......	......	......	......	......	......
East Bethel	9	63	16	17	35.6	2.40	1, 2	45	25	—13	24.4	2.02
Woodstock	2, 5	51	16	15	34.2	1.87	1	44	30	—12	22.6	2.56
Near St. Albans	3	62	30	19	34.8	2.30	1, 2	42	29	—11	22.5	2.70
West Charlotte	2, 9	60	16, 20	20	38.4	2.38	2	49	30	— 4	27.7	1.44
Panton	9	59	20	19	35.5	2.38	2	46	30	—12	24.9	2.12
Castleton	9	62	16	22	37.3	1.64	2	47	30	— 3	26.7	0.47
Averages	......	......	......	......	35.2	3.02	......	......	......	......	23.1	1.80
MASSACHUSETTS.												
Kingston	9	66	17, 30	28	43.4	2.65	2	53	25, 30	0	33.0	3.15
Topsfield	......	......	......	......	......	......	1, 2	48	30	— 2	28.9	3.39
Lawrence	3	65	17	25	41.1	3.62	2	50	30	0	30.6	3.03
Newbury	......	......	......	......	......	......	2	50	30	1	30.1	......
Georgetown	2	65	17	23	41.0	4.53	2	50	25	4	29.8	4.45
Milton	3	68	17	25	43.4	3.08	2	65	30	3	34.1	2.38
Cambridge	3	68	17	27	44.0	......	2	53	25	4	33.0	......
North Billerica	3	66	17	16	40.5	2.50	2	50	25	5	30.5	......
West Newton	......	......	......	......	......	......	5	56	25	— 6	33.1	4.35
New Bedford	3	61	19	29	43.4	3.15	2	51	30	4	32.1	3.35
Worcester	2	62	19	27	40.3	3.48	1, 2, 4	48	25	5	29.1	4.10
Mendon	3	66	17	23	40.4	3.40	4, 13	50	30	— 2	28.2	1.20
Lunenburg	2	65	19	26	40.3	2.55	2	50	30	0	28.4	5.02
Amherst	2, 9	61	17	25	39.1	3.28	2	47	30	1	28.0	1.84
Richmond	2	60	11, 17	26	37.4	3.12	5	47	25, 29	2	27.6	1.75
Williams College	2	62	16	18	37.1	2.25	1	49	30	— 3	26.6	0.76
Hinsdale	9	58	16, 19	18	33.6	3.98	4	56	25	— 4	25.6	0.95
Averages	......	......	......	......	40.4	3.20	......	......	......	......	29.92	2.84
RHODE ISLAND.												
Newport	2	66	17	28	42.3	2.38	2	51	25, 30	10	35.6	3.06
CONNECTICUT.												
Columbia	2	68	20	24	42.5	3.40	7	58	30	0	30.6	3.47
Middletown	2	66	20	19	41.3	2.45	4	55	30	— 2	31.2	2.30
Southington	2	63	19	25	41.4	2.88	4	53	30	— 1	30.5	1.92
Colebrook	2	62	19	20	37.5	3.09	......	......	......	......	......	......
Brookfield	6	65	17	23	43.6	2.35	2	60	30	10	34.8	......
Round Hill	......	......	......	......	......	......	4	51	30	0	29.5	1.68
Averages	......	......	......	......	41.3	2.83	......	......	......	......	31.3	2.34

Meteorology of 1870—Continued.

State and station.	NOVEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	DECEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
NEW YORK.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Moriches	2, 9	60	17	16	39.0	3.37	2	51	30	— 4	29.5	3.32
South Hartford	2	68	16	22	40.7	1.13	1	54	30	— 9	28.4	1.73
Caldwell	2, 5	54	16	14	35.6	2.15	2	46	30	—20	24.1	2.81
Garrison's	9	58	16, 19	25	40.9	2.22	1, 2	50	30	7	33.0	2.06
Throg's Neck	1, 9	64	19, 20	26	44.9	......	4, 5	52	30	4	32.7	......
White Plains	2	72	16	29	45.2	......	3	53	30	4	32.8	......
Cooper Union	9	65	20	30	46.7	2.41	2	55	30	12	35.9	2.83
Flatbush	8	65	19	29	43.8	0.93	11	55	29	9	34.4	3.19
Brooklyn	9	66	19	32	46.7	2.25	5	56	30	10	35.8	1.85
Glasco	15	58	10	22	37.0	2.70	2, 7	58	30	— 3	30.2	2.10
Newburg	2	66	19	29	44.7	1.90	2	54	30	9	33.0	1.33
Minaville	2	60	15	20	36.6	1.60	1	48	29	0	25.2	1.30
Cooperstown	2	64	16	19	37.0	1.92	5	50	23, 29	— 2	25.0	1.96
Gouverneur	2	63	22	14	34.5	1.71	1, 2, 6	44	29	—17	21.3	3.34
North Hammond	2, 3	65	22	24	39.4	2.14	1, 2, 3, 4, 13	46	29	— 8	25.0	2.50
Utica	2	59	16	20	37.6	2.09	4	47	29	— 4	27.4	3.31
South Trenton	2	61	22	16	34.9	2.58	1, 4	48	29	— 6	24.6	2.45
Cazenovia	2	62	22	15	36.8	......	5	48	29	— 5	25.5	......
Oneida	......	......	......	......	......	......	2, 4	47	29	— 4	27.8	3.56
Depauville	2	66	22	20	36.8	1.95	2, 4	41	29	— 9	24.2	3.57
Oswego	2	63	22	25	39.6	2.75	1	48	29	2	29.0	3.33
Palermo	2	63	16, 22	19	36.1	3.00	5	47	29	— 9	24.9	1.55
North Volney	2	65	22	21	38.3	......	4, 5	47	29	— 4	27.0	......
Nichols	2	66	16	17	37.1	......	5	53	22	2	28.3	......
Newark Valley	2	66	16	14	36.9	1.00	5	56	30	— 8	27.5	2.20
Himrods	2	63	19	20	37.4	0.69	1, 4	50	29	0	26.7	1.44
Little Genesee	2	68	11	12	35.8	3.15	4, 5	50	29	— 3	25.8	3.03
Angelica	......	......	......	......	......	......	5	55	29	— 2	28.1	......
Suspens'n Bridge	2, 8	65	19	23	39.9	2.85	4	52	29	7	28.3	3.95
Lockport	8	67	22	22	38.5	2.54	4	47	29	4	28.1	3.26
Buffalo	8	66	22	22	40.0	2.89	5	49	29	2	29.3	3.44
Averages	......	......	......	......	39.4	2.16	......	......	......	......	28.3	2.62
NEW JERSEY.												
Paterson	9	64	16, 20	27	43.3	2.68	2, 5	53	30	5	32.7	1.36
Newark	9	65	19	34	43.7	2.46	2, 4	53	30	6	33.4	2.19
South Orange	9	69	19	25	43.1	3.18	4	56	30	2	31.8	2.58
Trenton	9	74	20	29	47.9	1.67	5	55	30	8	37.0	0.90
Rio Grande	2	69	20	25	46.7	4.75	4	57	24	10	34.5	4.30
Moorestown	9	72	16, 20	26	43.4	1.95	4, 5	57	30	5	33.6	1.59
New Germantown	29	65	19	20	42.1	1.68	2	54	30	2	31.3	1.86
Haddonfield	9	70	20	26	43.3	1.88	4, 12	55	30	5	33.4	1.59
Greenwich	9	71	25	30	46.3	1.65	5	58	21, 25	11	35.5	1.60
Vineland	9	71	20	25	44.2	2.80	4, 5, 12	57	25	7	34.1	2.32
Averages	......	......	......	......	44.4	2.47	......	......	......	......	33.7	2.03
PENNSYLVANIA.												
Nyces	2	64	16	15	37.5	2.22	1, 4	50	30	— 5	25.8	1.04
Hamlinton	2	70	16, 17, 19	25	40.0	1.50	4	52	30	0	32.0	1.13
Dyberry	......	......	......	......	......	......	4	52	30	— 9	25.5	1.55
Fallsington	9	68	19	27	44.5	1.50	4, 5	56	30	6	33.0	1.80
Philadelphia	9	70	20	30	46.9	1.97	5	59	24	12	36.8	2.12
Germantown, (M)	29	67	19	28	41.1	......	1	60	30	2	33.3	......
Do. (T)	2	66	20	27	44.9	2.23	......	......	......	......	......	......
Horsham	2	67	20	26	43.3	1.30	4	57	30	6	33.1	1.50
Plymouth Meet'g	2	68	17, 20	26	43.4	2.27	4	58	30	1	33.1	1.49
Egypt	28, 29	60	18	20	41.5	......	4	55	30	4	31.6	......
Factoryville	2	64	16	17	37.4	1.83	5	53	30	— 2	27.7	1.65
Reading	2	67	16	29	46.1	2.09	4	59	24	12	36.1	2.39
West Chester	9	67	22	23	42.2	1.99	4	57	30	5	31.9	2.19
Parkersville	2, 29	64	17, 19	24	42.7	1.42	2, 5	56	30	1	32.8	2.00
Tamaqua	......	......	......	......	......	......	5	48	26	—10	25.6	......
Catawissa	1	70	16	22	40.4	......	4	60	23	9	35.2	......

Meteorology of 1870—Continued.

State and station.	NOVEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	DECEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
PENN.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Ephrata	29	64	16, 19	25	43.4	1.59	4	58	30	4	31.9	2.00
Mount Joy	2, 17	67	16	29	45.1	......	......	......	......	......	......	......
Carlisle	29	66	20	24	42.7	1.75	4	61	24	8	33.2	2.35
Fountain Dale	2, 28, 29	62	20	29	43.6	1.28	4	61	24, 30	5	38.0	2.10
Tioga	2	64	16	16	37.3	0.75	3	54	30	0	27.8	1.10
Lewisburg	2	61	16	20	39.6	1.60	4	57	24, 30	4	30.2	1.53
Grampian Hills	2	64	11	18	34.6	1.55	4	51	24	— 6	23.2	3.30
Johnstown	2	67	11	24	40.1	1.32	5	60	24	0	30.3	......
Franklin	2	67	11	24	38.0	2.35	4	55	23,24,29	2	28.0	4.66
Pittsburg	2	67	19	29	43.0	1.30	5	57	24	2	31.7	2.00
Connellsville	2	71	19	24	41.6	......	5	62	24	— 2	29.0	......
Brownsville	2, 8	70	19	26	44.0	......	5	62	24	0	32.0	......
Newcastle	2, 8	60	11	23	40.6	2.20	4	55	25	1	27.9	1.50
Beaver	2, 8	65	11	27	41.7	......	5	56	24	4	31.0	0.70
Canonsburg	2	78	11	22	41.7	1.06	4	62	24	— 1	30.1	1.78
Averages	....	......	....	......	41.7	1.68	....	......	....	......	30.8	1.90
DELAWARE.												
Milford	5	65	20	24	44.3	2.20	5	58	27	6	33.5	1.06
Dover	9	73	20	28	46.7	1.10	2	58	24,25,30	10	35.8	0.97
MARYLAND.												
Woodlawn	9	67	20	24	44.5	2.24	2	60	24	6	33.1	1.84
Fallston	29	72	20	27	47.0	1.66	4	65	24	7	34.2	2.10
Annapolis	9	74	20	25	49.1	1.82	4	60	30	6	37.7	1.33
Woodstock Coll.	....	......	....	......	......	......	4	59	30	4	32.4	1.22
Mt. St. Mary's	29	64	20	25	43.4	1.83	5	59	24	5	32.8	2.05
Averages	....	......	....	......	46.0	1.89	....	......	....	......	34.0	1.71
DIST. OF COLUMBIA.												
Washington	9, 29	65	19	31	46.5	1.37	5	58	24	8	36.0	0.95
VIRGINIA.												
Johnsontown	9	76	20	28	50.0	2.00	5	66	30	9	38.7	2.15
Hampton	2, 5	72	20	25	49.9	1.55	4, 5	65	25	6	38.7	2.50
Surry C. H	9	78	20	20	49.4	2.54	5	71	25	— 4	38.2	3.80
Comorn	9	71	16, 19	31	48.2	0.94	5	61	25	6	35.9	0.99
Vienna	29	69	20	32	46.8	1.30	5	59	25	8	34.8	3.40
Fairfax C. H	1	70	16	23	39.2	0.50	4, 5	60	24, 25	10	32.1	0.60
Accotink	9, 29	68	19, 20	24	44.8	1.75	4, 5	60	30	4	33.0	1.45
Piedmont	13, 29	67	20	22	44.3	1.80	4	63	30	3	36.6	2.30
Piedmont Station	27, 29	69	20	20	41.8	2.00	5	64	30	2	32.3	2.30
Staunton	13, 14	66	16, 19	29	44.9	1.56	4, 5	60	24	5	32.3	2.05
Lexington	13	66	16, 20	18	41.3	1.77	5	65	25	— 2	31.2	2.04
Lynchburg	2, 13	68	20	31	49.2	1.63	4	62	24	9	38.1	1.13
Near Wytheville	2	66	20	20	41.9	1.55	4	60	24	— 4	31.4	1.40
Averages	....	......	....	......	45.5	1.61	....	......	....	......	34.9	2.01
NORTH CAROLINA.												
Goldsboro	3, 5, 9	80	17	28	53.4	2.00	5	72	25	8	42.5	3.40
Warrenton	9, 30	69	21	32	49.3	1.90	5	67	24, 25	7	38.7	2.60
Oxford	9, 13	70	20	26	47.2	2.40	5	63	25	5	36.2	2.60
Albemarle	13	76	20	15	46.3	1.97	2, 4, 5	70	25	0	36.2	2.91
Statesville	9	66	19	18	46.0	0.75	2	56	24, 25	0	32.3	4.06
Asheville, (A)	2	69	20	19	44.7	1.80	5	64	24, 25	— 1	31.2	2.70
Do...(H)	1, 2	66	20	18	44.1	......	5	62	24, 25	0	33.0	......
Averages	....	......	....	......	47.3	1.80	....	......	....	......	36.2	3.04

Meteorology of 1870—Continued.

State and station.	November. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	December. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
SOUTH CAROLINA.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Bluffton	3, 8	86	17, 18, 19, 20	39	60. 9	4. 20	5	68	24	18	48. 4	5. 20
Gowdeysville	9	70	20	27	52. 1	2. 50	4, 5	69	25	7	41. 6	5. 10
Aiken	3	78	19	29	52. 7	2. 11	5	75	24	10	43. 7	1. 53
GEORGIA.												
Berne	1, 9	76	20, 27	34	55. 7	0. 75	19	72	25	16	46. 9	2. 10
St. Mary's	9	80	26	34	58. 9	2. 65	19	75	25	18	50. 0	3. 07
Penfield	3	78	17,19,20	30	52. 0	2. 95	5	69	25	7	41. 1	3. 40
Atlanta	16	76	17,19,20	32	54. 0	4. 62	4	67	24	4	40. 5	3. 16
Averages					55. 1	2. 74					44. 6	2. 98
ALABAMA.												
Rockville	2, 5	77	19	19	50. 6	3. 25	5	70	24	3	40. 3	4. 00
Carlowville	2	84	23	32	54. 9	8. 66	7	72	24	12	44. 8	7. 70
Selma	2, 3	85	17, 19	31	57. 0	5. 15	5	74	24	14	46. 8	5. 20
Greene Springs	4	80	17	25	52. 3	7. 35	7	72	24	9	42. 6	5. 13
Coatopa	4	83	17	26	53. 4	5. 30	5	73	24, 25	11	44. 0	5. 80
Fish River	5	76	20	34	......	1. 40	1, 6, 7	64	24	22	......	5. 25
Averages					53. 6	5. 18					43. 7	5. 51
FLORIDA.												
Near Port Orange	2, 4, 14	78	24	35	63. 2	2. 02	17, 19	76	24	25	55. 0	3. 30
Jacksonville	2	85	23	40	62. 7	4. 29	6, 8, 19	73	25	19	53. 3	1. 95
Pilatka	9	90	17, 24	38	64. 6	3. 60	31	80	25	22	51. 6	3. 11
Newport	3	81	20	29	57. 3	2. 60	2	70	25	9	49. 9	2. 15
Chattahoochee	......	......	......	......	......	......	14	87	25	15	......	9. 50
Averages					62. 0	3. 13					52. 4	4. 00
TEXAS.												
Clarksville	8	78	22, 25	38	59. 7	......	4	68	24	15	45. 4	......
Gilmer	2	90	22, 25	29	58. 1	4. 90	4	78	23, 24	18	47. 5	2. 79
Houston	......	......	......	......	......	......	4, 6	80	23	19	51. 5	......
Oakland	4	88	25	34	63. 9	2. 10	4	78	23	15	49. 8	1. 00
Blue Branch	6	99	25	28	62. 1	2. 60	6, 31	74	23, 24	10	46. 5	2. 70
Bluff	3, 4, 5	86	22, 25	34	62. 3	2. 62	4	76	23, 24	18	49. 2	1. 37
Clinton	2	89	25	31	62. 1	5. 50	4	77	23	17	50. 7	1. 10
Austin	2	90	25	30	60. 1	3. 49	4	75	23	11	45. 9	1. 30
San Antonio	2	89	25	30	61. 2	3. 46	31	79	23	15	47. 7	0. 60
Averages					61. 2	3. 52					48. 3	1. 55
LOUISIANA.												
New Orleans	4	85	17, 22	34	59. 1	6. 55	7	76	24	19	49. 2	8. 45
Shreveport	2, 5	80	17	30	45. 6	......	......	......	......	......	......	......
Ponchatoula	2, 3	90	17	29	60. 5	4. 22	5	80	24	16	50. 3	9. 01
MISSISSIPPI.												
Columbus	5	80	17	25	52. 1	3. 36	5, 7	70	24	9	41. 5	3. 21
Enterprise	6	89	23, 24	31	56. 1	......	3	64	24	11	43. 9	......
Philadelphia	......	......	......	......	......	......	5, 7	73	24	8	42. 7	4. 50
Grenada	5	86	19	22	58. 2	1. 45	5	76	24	7	43. 0	3. 50
Near Brookhaven	3	84	17	26	54. 4	4. 80	7	75	24	9	43. 9	7. 80
Clinton College	......	......	......	......	......	......	7	74	24	11	43. 8	......
Holly Springs	5	67	22	37	58. 0	0. 70	......	......	......	......	......	......
Averages					55. 8	3. 58					41. 3	4. 75

Meteorology of 1870—Continued.

State and station.	NOVEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	DECEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
ARKANSAS.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Helena	4, 5	*86	26	31	54. 8	......	7	73	24	4	38. 5	......
Mineral Springs	2	80	22	24	52. 2	2. 75	4, 5	66	24	8	40. 3	4. 50
Fayetteville	3	82	22	20	52. 7	2. 05	2, 3	72	24	—12	33. 0	2. 74
TENNESSEE.												
Elizabethton	2	72	19, 20	22	41. 9	0. 95	4	60	25	— 2	33. 2	0. 65
Tusculum Coll	......	......	......	......	......	......	5	64	25	0	33. 1	......
Knoxville	2	74	18	22	43. 4	1. 50	5	65	24	— 1	......	1. 70
Lookout Mount'n	6	72	19, 23	30	51. 0	......	5	67	24	— 2	37. 1	......
McMinnville	2	75	19	22	47. 5	2. 01	5	68	24	0	36. 9	3. 20
Clarksville	4	79	19	24	47. 9	0. 95	4, 5	65	24	0	35. 7	3. 07
La Grange	4	83	21	29	51. 3	1. 90	4	66	24	4	37. 3	4. 70
Averages	......	......	......	......	44. 7	1. 46	......	......	......	......	35. 5	2. 66
KENTUCKY.												
Pine Grove	2	72	19	20	43. 9	2. 46	5	64	24	— 6	31. 1	2. 36
Danville	2	75	19	26	47. 7	1. 26	5	70	24	— 4	34. 9	2. 64
Shelby City	2	76	19	24	46. 6	1. 91	5	65	24	— 4	31. 1	2. 48
Near Louisville	2	75	19	20	46. 6	2. 40	4, 5	58	24	— 2	33. 4	2. 20
Averages	......	......	......	......	46. 2	2. 01	......	......	......	......	33. 4	2. 42
OHIO.												
Salem	2, 8	70	25	22	39. 5	1. 84	5	59	25	— 6	27. 2	2. 79
Steubenville	2, 8	63	11, 19	28	43. 0	1. 25	4	54	24, 25	2	31. 0	1. 73
Painesville	8	68	25, 26	28	40. 9	3. 88	5	54	25	— 1	26. 0	6. 10
Milnersville	8	62	11	20	35. 8	1. 40	1, 2, 3	50	24	— 4	......	0. 58
Cleveland	8	72	25	22	40. 2	3. 07	5	58	24, 25	1	28. 9	2. 82
Wooster	......	......	......	......	......	......	5	65	24	— 4	30. 3	......
Pennsville	......	......	......	......	......	......	5	54	24	— 6	28. 9	3. 00
Gallipolis	2	72	16	28	45. 2	1. 35	5	63	24	— 1	31. 3	2. 28
Adams' Mills	8	68	19	21	42. 2	1. 56	5	61	24	— 4	31. 0	2. 10
Oberlin	8	71	25	18	38. 0	2. 60	5	58	24	— 5	27. 2	2. 35
Kelley's Island	8	70	19	30	43. 2	1. 64	5	55	23, 24	0	29. 9	2. 23
Sandusky	8	72	19, 25	27	41. 8	2. 95	5	57	24	— 1	29. 7	2. 48
Carson	8	70	25	24	42. 6	1. 95	1	52	23	0	29. 8	1. 60
North Fairfield	8	74	19	24	42. 7	2. 16	4	60	24	— 8	28. 5	1. 81
Gambier	8	64	19	22	39. 0	1. 48	......	......	......	......	......	......
Westerville	2	70	19	20	40. 9	1. 63	5	61	24	— 7	29. 2	2. 43
North Bass Island	2	67	19	27	42. 9	3. 01	5	56	25	— 2	29. 5	2. 08
Marion	2, 8	67	19	18	38. 9	2. 42	1, 3, 4	49	24	— 9	26. 5	2. 63
Hillsboro	2	66	25	21	42. 3	1. 59	5	60	24	— 6	29. 1	2. 41
Bowling Green	2	73	19	21	42. 5	1. 65	4, 5	57	23	—10	29. 3	3. 75
Kenton	2	61	19	30	42. 3	1. 75	5	62	24, 25	—12	31. 5	5. 08
Bellefontaine	2, 8	68	19	26	40. 3	2. 25	5	58	24	—14	26. 7	2. 72
Urbana	8	69	17, 24	23	40. 4	1. 90	4	53	24	—12	26. 9	3. 13
Bethel	2	72	24, 25	17	42. 1	1. 50	5	63	24	— 8	29. 2	2. 10
Carthagena	8	70	10, 22	27	43. 5	2. 75	5	59	24	—15	28. 7	3. 81
Jacksonburg	2, 8	74	19	29	44. 2	1. 50	4	57	24	—12	29. 7	3. 10
Mt. Auburn Inst.	2	71	19	28	45. 5	2. 21	4	60	24	—10	30. 9	2. 09
Cincinnati, (H)	8	75	24	24	45. 0	1. 50	4	60	24	— 8	30. 4	2. 17
Do. .....(P)	2	67	19, 23, 24	27	44. 2	1. 40	5	63	24	— 7	31. 8	2. 30
College Hill	2	72	19, 23, 24	27	43. 8	2. 00	3, 4, 5	52	24	—10	29. 4	2. 25
Averages	......	......	......	......	41. 9	2. 01	......	......	......	......	29. 2	2. 66
MICHIGAN.												
Detroit	2	68	19	22	39. 0	2. 00	4	55	23	—11	27. 2	2. 90
Monroe City	......	......	......	......	......	......	4	60	24	— 5	29. 2	1. 40
Ann Arbor	2, 8	64	19	22	38. 8	2. 10	4	58	23, 25	— 4	27. 9	4. 95
Alpena	12	56	21	26	38. 5	0. 96	1	44	23	6	27. 4	2. 02
State Agr'l Coll	......	......	......	......	......	......	4	52	23	—11	24. 8	2. 57
Olivet College	......	......	......	......	......	......	4	49	29	— 4	24. 7	3. 97

Meteorology of 1870—Continued.

State and station.	NOVEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	DECEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MICH.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Litchfield	2	66	22	19	37.1	1.98	4	52	29	—12	24.3	2.36
Cold Water	2	66	22	18	38.2	1.44	4	53	23, 24	— 8	24.7	3.50
Grand Rapids (H)	2	69	22	16	39.4	1.37	4	52	23	— 2	27.5	4.75
Do (S)	8	65	22	16	39.6	0.88	1, 4, 5	49	23	—11	27.9	3.89
Northport	1	62	21	23	39.0	1.58	4	49	22	10	27.6	3.08
Benzonia	8	61	21	20	39.4	1.30	4	49	23	10	28.3	4.01
Copper Falls	1	50	21	9	32.0	1.85	3	41	23, 24	— 3	19.3	3.73
Ontonagon	2	50	21	20	39.0	0.90	1	46	22	— 2	24.9	......
Averages	....	......	....	......	38.2	1.58	....	......	....	......	26.1	3.32
INDIANA.												
Fort Wayne	....	......	....	......	......	......	4	59	24	—16	27.4	6.71
Aurora	4, 8	70	24	22	43.4	1.16	15	76	24	— 8	30.7	2.37
Vevay	2	74	19, 23	24	44.9	1.50	5	61	24	— 4	32.1	2.13
Mount Carmel	2	68	19	23	41.2	......	1, 4	54	24	—10	26.5	2.07
Spiceland	2, 8	71	23	22	41.1	1.75	4	56	24	—11	28.4	1.70
Laconia	2, 4	74	19	22	45.7	2.26	4	60	24	— 4	33.8	2.74
Columbia City	2	69	10, 14, 19, 22	32	44.1	1.94	3, 5	58	24	—16	30.2	0.93
Knightstown	2	71	23	20	42.6	1.62	4	56	24	—15	27.6	2.15
Warsaw	28	65	22	28	......	2.33	4	62	24	—14	27.8	1.04
Indianapolis	2, 8	71	19	20	42.7	1.27	4	57	24	—15	28.1	1.93
Near Laporte	8	65	22	24	53.7	0.70	3	58	24	—12	27.4	1.82
Annapolis	28	68	19	16	39.1	1.10	1, 4	56	23	—26	25.3	1.60
Merom	2	73	19	26	46.5	1.50	4	60	24	— 8	31.6	1.45
Kentland	....	......	....	......	......	......	1	61	23	—21	26.3	5.28
New Harmony	2	72	19	23	46.8	1.27	1	57	24	— 2	32.4	2.03
Averages	....	......	....	......	44.3	1.53	....	......	....	......	29.0	2.40
ILLINOIS.												
Chicago	8	69	19	27	43.8	1.16	1	53	23, 24	— 9	28.3	2.46
Near Chicago	28	74	19	22	42.0	......	1	56	23	—14	26.9	......
Evanston	2	66	19	22	40.2	1.58	2, 5	48	23, 24	—10	26.3	2.15
Marengo	8	68	19, 22	17	37.8	0.69	4	50	23	—18	22.5	1.50
Charleston	2	73	19	17	41.9	2.01	4	59	23	—22	26.5	1.85
Mattoon	1, 2	68	22	21	43.7	3.00	4	54	24	— 8	28.4	2.38
Aurora	8	67	19, 22	19	38.2	1.51	4	52	24	—23	23.4	1.47
Louisville	2	79	19	20	46.4	1.80	1, 4	60	24	—14	30.4	2.60
Belvidere	8, 12	64	22	11	36.6	2.33	1	55	23	—15	22.8	2.53
Ottawa	8	69	21, 22, 30	26	42.9	1.58	....	......	....	......	......	......
Decatur	2	69	19, 22	20	43.4	1.68	4	60	24	—14	27.1	2.25
Pana	2	72	22	22	42.9	1.25	1, 4	58	24	—11	27.2	1.65
Winnebago	12	62	21, 22	17	37.5	0.60	5	57	23	—15	21.5	0.78
Rochelle	2	63	19, 22	20	38.2	......	4	53	23	—15	24.0	......
Wyanet	12	73	22	19	44.1	1.84	2	60	23	—13	26.2	1.53
Hennepin, (S)	8	70	22	17	43.0	......	1	56	24	—12	25.0	......
Do (O)	1, 2, 28	66	22	18	41.9	2.10	1, 4	56	23	—11	26.2	1.10
Peoria	2, 28	68	22	20	43.3	1.21	4	56	23, 24	—13	27.7	1.07
Havana	28	70	22	15	41.6	2.50	1, 2, 4	56	23	—19	26.4	1.71
Waterloo	2, 4	72	22	20	44.2	......	4	37	23	— 6	29.0	1.07
Dubois	2	75	23	22	46.2	2.20	1	65	24	—16	30.6	2.15
Galesburg	12	66	22	22	43.1	0.60	30	69	23	—10	27.3	1.08
Manchester	27	78	22	20	44.0	1.65	9	68	24	—13	27.7	2.30
Mount Sterling	28	69	22	22	45.8	1.55	4	59	24	— 7	29.7	2.22
Andalusia	3	64	22	18	41.7	......	30	54	23	— 8	26.4	......
Oquawka	12	80	22	20	44.2	1.67	1	59	23, 24	— 5	28.5	0.62
Augusta	12, 27, 28	69	22	17	42.9	1.40	4	62	24	—12	27.0	1.41
Warsaw	1	71	16, 18, 22	25	43.9	1.53	3, 4	57	24	—10	27.1	1.29
Averages	....	......	....	......	42.3	1.63	....	......	....	......	26.7	1.70

Meteorology of 1870—Continued.

State and station.	November.						December.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
WISCONSIN.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Sturgeon Bay	2. 26	58	21	18	38. 8	1. 15	1, 4	46	24	— 3	24. 9	2. 39
Manitowoc	2	60	19	20	40. 0	0. 68	2	48	23	—10	25. 6	2. 13
Hingham	8	65	21	20	40. 4	......	2	48	23, 24	—10	24. 3	......
Milwaukee	8	69	22	20	30. 0	0. 94	2	50	23, 24	—10	25. 2	1. 79
Geneva	2	62	21	14	38. 3	1. 20	2	49	23	—17	21. 7	1. 77
Waupaca	1, 27	60	21	18	38. 2	......	2	49	23, 24, 29	—10	24. 2	1. 20
Embarrass	27	62	21	16	36. 5	2. 15	2	54	23	—14	21. 4	1. 25
Rocky Run	8	71	21	16	38. 4	0. 68	2	49	29	—14	23. 2	1. 40
Madison	8	64	22	19	38. 7	0. 33	2	48	24	—13	22. 2	0. 67
Edgerton	27	66	19, 21, 22	20	40. 6	0. 90	3	55	23, 24	—12	21. 9	0. 90
Mosinee	13, 27	55	21	10	32. 5	2. 82	4	48	23	—24	17. 3	1. 66
Baraboo	5	60	21	0	29. 7	1. 13	3	50	23	—16	22. 3	4. 00
Tunnel City	27	60	21	12	37. 6	0. 70	3	48	24	—18	......	......
Bayfield	26	60	21	8	36. 5	......	1	50	23	—12	21. 6	......
Averages	....	......	....	......	36. 8	1. 15	....	......	....	......	23. 0	1. 74
MINNESOTA.												
Beaver Bay	26	62	21	20	36. 3	1. 04	1, 2, 15	43	22, 28	—16	21. 9	4. 80
St. Paul	1	64	18	19	38. 4	1. 38	3	52	23	—15	19. 7	0. 90
Minneapolis	1	63	21	6	36. 8	1. 76	1	53	23	—21	17. 3	0. 60
Sibley	3	60	21	10	36. 4	1. 50	3	53	23	—21	18. 8	0. 10
Koniska	1	60	21	4	35. 4	0. 60	2	54	23	—20	19. 2	0. 45
Litchfield	1	64	21	16	38. 5	0. 90	1	54	26	—14	18. 5	0. 30
New Ulm	1	68	21	14	39. 4	1. 10	3	55	23	—20	20. 7	0. 35
Madelia	25	74	21	10	38. 6	1. 54	2, 3	70	23	—22	28. 8	1. 00
Averages	....	......	....	......	37. 5	1. 23	....	......	....	......	20. 6	1. 06
IOWA.												
Clinton	30	70	18, 21, 22	18	37. 5	0. 76	2	61	23	—14	25. 1	0. 52
Waukon	1	62	18	18	36. 7	......	2	47	23, 24	—16	......	......
Dubuque	6	60	22	22	39. 7	0. 96	1, 2	51	23	—12	24. 0	0. 68
Monticello	2, 12, 26	60	21	17	38. 0	0. 61	1, 3	53	23	—12	22. 7	0. 54
Muscatine	12	62	21, 22	21	39. 7	0. 82	....	......	....	......	......	......
Bowen's Prairie	1	70	16, 18, 21	20	39. 4	0. 50	3	52	23	—18	23. 7	0. 80
Fort Madison	28	65	22	19	42. 8	1. 00	4	56	23, 24	— 8	28. 4	0. 72
Guttenberg	1	64	18, 21	16	36. 7	......	3	52	23, 24	—14	20. 2	......
Mount Vernon	12	61	21, 22	19	38. 0	......	1	52	23	—14	23. 4	......
Iowa City	1	66	22	20	39. 4	0. 91	1	54	23	—11	24. 4	0. 35
Independence	1	61	16, 18	18	37. 6	0. 80	3	52	23	—15	20. 9	0. 90
Near Independ'ce.	1, 26	62	19, 24	12	38. 0	0. 70	3	53	23	—17	19. 5	0. 70
Rockford	1	62	18	20	37. 8	......	4	54	23	—11	23. 3	0. 45
Iowa Falls	....	......	....	......	......	......	2	62	25	—16	23. 3	0. 56
Algona	1	66	21	8	37. 8	......	3	57	23	—17	21. 1	0. 40
Webster City	26	67	21	10	33. 3	0. 00	2	54	23	—14	22. 1	0. 06
Boonesboro	1	62	21	11	38. 0	0. 80	3	53	23	—14	23. 4	......
Fontanelle	1, 7, 27	67	21	13	40. 4	0. 63	3	53	23	—14	24. 0	0. 10
Grant City	26	71	21	10	40. 2	0. 00	3	60	23	—20	21. 8	0. 20
Sac City	26	68	21	10	39. 3	......	3	52	22, 23	—14	22. 3	0. 30
Logan	27	65	21	8	41. 6	0. 60	2	58	23	—17	24. 4	0. 20
Woodbine	3	78	21	8	39. 9	0. 03	2, 3	56	23	—19	23. 0	0. 31
West Union	11	76	18	19	40. 9	1. 17	2	61	22, 23	—18	21. 8	1. 40
Averages	....	......	....	......	38. 8	6. 08	....	......	....	......	23. 0	0. 51
MISSOURI.												
St. Louis	2, 4	74	22	25	47. 3	1. 87	4	58	24	— 4	32. 0	1. 89
Allenton	4	80	22	14	45. 9	2. 16	4	64	24	—16	29. 6	2. 85
Hematite	2	83	22	14	47. 0	2. 19	1	71	24	—25	31. 5	3. 62
Hannibal	1	69	22	22	44. 0	1. 51	4	66	24	—10	27. 4	1. 10
Rolla	4	77	22	15	45. 7	2. 55	4	62	24	—23	30. 5	2. 44
Jefferson City	27	78	22	21	46. 6	......	1	65	24	—10	26. 0	......
Kansas City	27	74	21	20	45. 5	0. 50	4	58	21	— 6	29. 4	0. 60

Meteorology of 1870—Continued.

State and station.	November. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	December. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
Mo.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Oregon	1, 12	74	21	17	45. 2	0. 35	3	63	23	—11	28. 8	0. 45
Corning	12	74	21	18	42. 7	0. 45	3	65	23	—13	27. 1	0. 35
Averages	......	......	......	......	45. 5	1. 49	......	......	......	......	29. 1	1, 66
KANSAS.												
Atchison	12	72	21	16	43. 5	0. 65	3	62	24	— 7	27. 6	0. 73
Williamstown	27	75	21	19	46. 3	0. 64	30	66	24	—10	30. 4	1. 12
Leavenworth	12, 27	72	21	17	44. 0	0. 76	3	62	24	—11	28. 3	0. 65
Williamsburg	26, 27	71	16	17	45. 2	......	2	65	23	—13	28. 9	......
Olathe	12, 27	71	21	15	43. 4	0. 50	4	63	24	—11	27. 1	0. 40
Paola	2	78	21	17	45. 6	0. 47	3, 4	63	24	—12	29. 3	0. 80
Baxter Springs	4	75	21, 22	22	48. 8	1. 50	4	64	24	—10	31. 7	0. 90
Lawrence	12	72	21	17	44. 9	0. 57	3	64	24	—10	28. 7	0. 72
Holton	12	71	21	14	43. 4	0. 50	4	66	23	—12	28. 2	0. 48
State Agr'l Coll.	27	74	21	17	45. 6	0. 13	4	68	23	—11	30. 1	0. 45
Council Grove	27	74	21	16	45. 6	0. 20	4	66	23	—12	29. 2	0. 50
Douglass	1	74	21	18	46. 6	......	3	66	23	— 7	31. 3	1. 28
Averages	......	......	......	......	52. 9	0. 59	......	......	......	......	29. 2	0. 73
NEBRASKA.												
Omaha Agency	26	72	18	22	44. 7	0. 10	3	70	23	—15	27. 1	0. 53
De Soto	27	67	21	13	41. 3	0. 07	3	57	23	—18	24. 7	0. 13
Bellevue	26	74	21	15	42. 9	0. 00	3	63	23	—11	28. 1	0. 10
Nebraska City	1, 26, 27	72	21	13	42. 0	0. 20	3	66	23	—14	26. 1	0. 17
Newcastle	1	72	21	10	......	......	3	68	23	—22	......	......
Averages	......	......	......	......	42. 7	0. 09	......	......	......	......	26. 5	0. 23
UTAH.												
Salt Lake City	1	76	23	25	......	......	11, 12	66	20	1	......	......
Coalville	26	62	24	14	37. 8	0. 79	1	52	22	—25	19. 1	1. 30
CALIFORNIA.												
Monterey	20	79	28	39	55. 0	1. 19	29	64	17, 18, 22	31	47. 2	2. 37
Chico	19	78	27	36	53. 3	3. 40	31	65	19	26	44. 9	2. 80
Watsonville	15, 16, 18, 19, 21	86	26, 27	33	56. 9	1. 50	29	73	18	28	49. 2	4. 50
Cahto	15, 18, 19	73	10	38	54. 4	4. 95	1, 29	58	16, 23	31	46. 0	14. 70
Visalia	20, 23	72	11, 26	37	49. 4	0. 75	30	65	23	21	41. 0	0. 30
Taylorsville	11	65	28	36	49. 7	......	17	56	16	10	38. 0	......
Averages	......	......	......	......	53. 1	2. 36	......	......	......	......	44. 4	4. 93
MONTANA.												
Deer Lodge City	25	60	8	15	34. 1	1. 17	31	56	21	—16	19. 2	0. 42
Missoula	3	60	29	24	37. 1	0. 15	30	56	18	— 4	21. 0	0. 35
COLORADO.												
Denver City	24	68	14	20	41. 8	0. 54	3	60	21	—18	23. 0	0. 73
WASHINGTON.												
Port Angeles	1, 2, 8, 15, 16, 18, 21, 22, 23	53	7	40	48. 8	15. 32	10, 28	48	18, 21, 22	37	43. 4	16. 82
Cathlamet	23	61	20	32	45. 8	......	30	52	21	16	35. 7	......
OREGON.												
Portland	12	66	17	37	48. 0	6. 05	30	61	21	18	38. 0	4. 40
Eola	24	55	6	28	42. 3	5. 05	30	53	21	9	33. 7	4. 38
Astoria	22	58	7	37	47. 3	10. 31	30	53	20	27	37. 9	10. 11

DONATIONS TO THE AGRICULTURAL MUSEUM.

Name.	Residence.	Article.
Abbott, Hon. J. H	Abbottsburg, N. C	Upland cotton and North Carolina rice.
Adams, Mrs. L. B	Constantine, Mich	Specimens of insects.
Akhurst, John	Brooklyn, N. Y	Five varieties silk cocoons and specimens of silk, (*Bombyx mori;*) larvæ of *Attacus pernyi*.
Antisell, Dr. T	Washington, D. C	Insects.
Army Medical Museum	do	Fir wood from Alaska; insects, spices, &c.; four lots.
Baily, G. W	New York City	*Plotus* or snake-darter of Florida.
Balsiger, J	Highland, Ill	Fine variety of grain.
Baker & Smith	Wanego, Kansas	Tappahannock and Touzelle wheat.
Bartlett, Levi	Warner, N. H	Seven specimens of wheat in the ear.
Beller, Jas. E	Berne, N. Y	Apples.
Belden, Samuel A	Brownsville, Texas	Pod of Mexican butterfly plant.
Billings, Dr. J. S	Surgeon General's Office	Honey ants from New Mexico.
Bliss, B. K., & Son	New York	Fifty-three varieties potatoes; four varieties onions; one barrel fancy gourds.
Boardman, G. A	Calais, Me	Skins of Florida ground-doves, snake-bird, and four other valuable skins.
Brand, G. V. D	Waupun, Wis	Red-fleshed apple, called the "Curiosity."
Bonnelli, Daniel	St. Thomas, Utah	Fiber of *Apocynum cannabinum*.
Bundick, Miss E	Camden, N. J	Wristlets manufactured from Angora wool.
Callam, Dr. C. S. N	Tenallytown, D. C	Curious growth of corn, from C. R. Belt.
Campbell, D. G	Baker County, Oregon	Large crickets, (alcoholic.)
Carpenter & Cross	Providence, R. I	Samples of worsted braids, from long wool.
Cary, James R	Blair, Neb	Fiber of *Apocynum*.
Cassidy, J. W	Petaluma, Cal	Prunes, (Pond's seedling.)
Cespides, Juan de Deos	Costa Rica	Wild silk.
Chamberlain, S. E	Waterford, Va	White guinea-fowls and improved white corn.
Chase, J. E	Holyoke, Mass	Insects.
Chavis, M	Los Vegas, N. M	Very large onion, grown on the farm of Lorenzo Labadi, at Agua Negro, N. M.
Clark, Charles	Washington, D. C	Colocynth, and large beans, (seed from South America.)
Clepper, L. G	Montgomery County, Tex.	Ramie.
Cornaby, Samuel	Spanish Fork, Utah	Samples of cocoons (*Bombyx mori*) grown on Osage orange.
Cover, J. C	Consul at Fayal, Azores, Portugal.	Specimens of lace-work made by native peasant women from the fiber of the bitter aloe.
Davison, C. E	Allegan, Mich	Fruits, to model.
Denig, E. C	Washington, D. C	Palmetto leaves, Florida.
De Leon, D. Camden	Albuquerque, N. M	Samples of beet-root and specimens of cotton.
Dickenson, O	Salem, Oregon	White Australian spring wheat.
Dillingham, J. P	New Berne, N. C	Fine specimens of southern corn.
Dodge, Allen	Georgetown, D. C	Large corn.
Dorr, R. L	Depauville, N. Y	Wool.
Douglass, A. H	Newark, N. J	Species of *Gecko*.
Downing, Charles		Collection of apples.
Drexler, Mrs. T	Washington, D. C	Bird-skins.
Eddison, R. W	Leeds, Eng	Ramie, China grass, prepared and raw.
Edwards, William H	Coalburg, W. Va	Collection of insects; two lots.
Elliot, R. S	Agent Kansas Pacific R. R.	Wheat grown at Carlyle Station, 2,948 feet above the sea.
Emmert, George W	Elizabethtown, Tenn	Specimen of *Dynastes tityus*.
Emms, J. P	Forestville, Minn	Stalk and fiber of *Apocynum*.
Erni, Dr. H	U. S. Consul, Basle, Switzerland.	Eighteen samples of aniline colors, from R. Geigy & Co.; silk-weaving on Jacquard loom; specimens of silks, ribbons, sashes, and other silk samples.
Fahnestock, S. S	Washington, D. C	Peck of very large potatoes.
Fleming, James	Toronto, Canada	Nineteen specimens of grain, &c., Canadian.
Fowler, Mrs. F	Washington, D. C	Cotton grown in District of Columbia.
Gibson, Hon. J. R	Eighth District, Virginia	Hottentot apple for modeling; other fruits also for modeling.
Glover, Prof. T	Washington, D. C	Large collection of foreign game birds.
Goodale, S. L	Saco, Maine	Specimens of wheat, rye, barley, &c., from Maine.
Goss, A. B	Lower Waterford, Vt	Maple-sugar.
Grant, Mrs. U. S	Executive Mansion, Washington, D. C.	Large pears from California.
Hampton, W. C	Mt. Victory, Ohio	Wheat, and New Brunswick oats.
Hatch, J. E	Stratford, Vt	Five samples maple-sugar; cakes and granulated specimens.
Heaton, J. C	Lavaca, Texas	Insects and cocoons.
Hershey, J. F	Spring Forge, Pa	White wheat.
Herr, A. D	Pine Grove, N. J	Red-cob gourd seed-corn.
Henderson & Fleming	New York City	Asylum sugar-corn.
Hillebrandt, H	U. S. Consul, Canea, Crete	Specimens silk, four qualities, (*Bombyx mori.*)
Humphrey, R. W	Floyd County, Iowa	Rio Grande spring wheat.
Hungarian Dep't of Agriculture, Industry and Trade.		Two hundred cases of seeds for museum.

Name.	Residence.	Article.
Hurt, Mrs. F. B	Abingdon, Va	Hybrid fowl.
Hutchings, J. M	Yosemite Valley, Cal	Insects and large almonds.
Judson & Sikes	Spriugfield, Mass	Joint corn, with packages of seed.
Kauffman, ——	Alexandria	Ferrets.
Keuling, J. H	Washington, D. C	Skins of "Least bittern."
Kingsland, G	Rutherford Park, N. J	Sample of corn.
Lamonte, F. A	Vandalia, Cal	Living centipede.
Law, J	Indiana	Fine cigars. Tobacco grown from Cuba seed sent out by the Department.
Lawrence, E	Plaquemine Parish, La	Sample of sugar. Very fine.
Lawrence, Miss Nannie B	Ocean County, N. J	Humming-bird nests.
Lefrano, E	New Orleans, La	Ramie cleaned by Lefranc's machine.
Lindley & Son	Greensboro, N. C	One hundred varieties Southern apples.
Mabrey, Mrs. C. W	La Grange, Ga	Cocoons (live) of *Bombyx mori.*
Mallison, M. N		Cotton from Canton, China.
McClary, Benj. R	Newport, Vt	Specimens.
McCought, Miss Eliza	Union County, Ky	Kentucky corn.
McGuire, J. C	Washington, D. C	Red squirrel.
Mechling, Mrs. F. E. D	British Honduras, Central America.	Large collection of snakes and reptiles, and insects.
Merritt, J. C	Farmingdale, N. Y	Sample of red-bearded Mediterranean wheat.
Meservey, C. A	Bangor, Me	Specimens of silk. Three samples of cocoons, &c.
Murphy, J. McL	Harlem, N. Y	Specimens of ixtle fiber.
Newman, Joseph	Columbia, S. C	Skins of birds and animals; Indian hatchet; insects.
Neumann, Joseph	San Francisco, Cal	Manufactured California silk.
Palmer, Dr. Ed		Specimens of insects; skins of birds and animals; specimens of grains, fibers, Indian food, &c., and rude Indian manufacture, from Sonora, Mexico, and Arizona.
Parry, Mrs. C. C	Washington, D. C	Singular corn; kernels inclosed in a husk.
Patterson, Mrs. C	do	Florida orange and lemon.
Pendleton, E. B	Westerly, R. I	Curious specimen of yellow pine.
Periam, Jonathan	Chatsworth, Ill	Samples 1, 2, 3 white sugar from native beets.
Phifer, L. L	Concord, N. C	Ramie.
Pleasants, T. S	Petersburg, Va	Peanuts.
Purdy, J	San Francisco, Cal	Sorghum sugar and sirup.
Ravenel, H. W	Aiken, S. C	Leaves of *Ilex Cassine*, a substitute for tea.
Read, J. B	Tuscaloosa, Ala	Okra paper.
Rosenhammer, M	Rattlesnake, Oregon	Bird-skins and insects.
Saunders, Wm	Washington, D. C	Pear, shaped like an apple.
Saunders, Wm	London, Canada	Fruits and collection of Canadian insects.
Sells, M	St. Louis, Mo	Prize cotton.
Sheed, H. D	Washington, D. C	Double apple from New Jersey.
Siddalls, J. H		Specimen of hemp, broken and scutched at one operation.
Smart, Charles	United States Army	Collection of microscopic insects from Lower California.
Smithsonian Institution	Washington, D. C	Bird-skins, from Hayden's Geological Survey; mounted pheasant, fibers, lace-bark, and bark-cloth, from Sandwich Islands; collections of insects, from Mazatlan, Rocky Mountains, Mississippi, and other localities; silk cocoons, &c.
Taylor, George	Washington, D. C	Chinese golden pheasant.
Thomas, C	De Soto, Ill	Collection of lepidoptera in papers.
Todd, James	New London, N. H	Collection of grain.
Toppan, C	Boston, Mass	Products of petroleum.
Townsend, Hon. W	Pennsylvania	Corn grown by David H. Bronson.
Trowbridge	Milford, Conn	Five varieties of cranberries.
Trouvelot, L	Medford, Mass	Silk from *Telea polyphemus;* silk fabric from *Samia cynthia.*
Tubman, R. T	Charles County, Md	Connecticut seed leaf tobacco.
Ulke, Henry	Washington, D. C	Prepared (dry) specimens of European caterpillars.
University of Virginia, (by exchange.)	Charlotteville, Va	Specimens of cottons, (silks, &c., foreign,) paper and paper materials, cocoa fiber, gums, resins, &c.
Wakefield, J	Fremont, Wis	Apple, to model.
Walker, Dr. R. L	Mansfield Valley, Pa	Bird-skin and Indian arrow-points.
Warder & Barnett	Springfield, Ohio	Samples of Ohio wheat.
Waller, W. L	Washington, D. C	Japan quince.
Whitman, J. A	Lewiston, Mo	Nonpareil white heron, night-hawk, &c.
Wilkinson, J. H	Washington, D. C	Specimens of salt and salt-brine, from Great Salt Basin, Lincoln, Neb.; minerals.
Willmuth, J. A. H		Canadian wheat, peas, &c.
Wilson, Wm. D	Iowa	Ramie fiber.
Wing, Minerva E	West Charlotte, Vt	Collections of insects, grain, fruit, &c.
Wingate, J. D	Bellefonte, Pa	Insects, two lots.
Wolter, Wm	Washington, D. C	Marsh owl.
Wrenn, A. H		Specimens of grain, potatoes, and sirup.
Zeledon, José C	Costa Rica	Caracolille coffee.

INDEX.

A.

B.

C.

D.

E.

F.

K.

N.

O.

P.

R.

T.

U.